

NERL/HEASD Publications

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Jan 1, 2001 - Dec 31, 2001

Presented Published

ABSTRACT/ORAL

Burke, J.M., Xue, J., and Ozkaynak, H. Population exposures to particulate matter: a comparison of exposure model predictions and measurement data. Presented at: 11th Annual Meeting of the International Society of Exposure Analysis, Charleston, SC, November 4-8, 2001.

11/4/2001

Contact: Janet M. Burke

Abstract: The US EPA National Exposure Research Laboratory (NERL) is currently developing an integrated human exposure source-to-dose modeling system (HES2D). This modeling system will incorporate models that use a probabilistic approach to predict population exposures to environmental pollutants, including ambient particulate matter (PM). A population exposure model for PM, called the Stochastic Human Exposure and Dose Simulation (SHEDS-PM) model, has been developed and applied using a case study of PM_{2.5} in Philadelphia, PA.

SHEDS-PM estimates the population distribution of PM exposures by randomly sampling from various input distributions, including both ambient PM concentrations and emission strengths for indoor sources of PM (e.g., cigarette smoking, cooking). A steady-state mass-balance equation is used to calculate indoor PM concentrations for the residential microenvironment using ambient PM concentrations and distributions of available physical factor data (e.g., air exchange, penetration, deposition). PM concentrations in non-residential microenvironments are calculated based on distributions of the effective penetration of ambient PM, which were produced using regression analysis of available measurement data for vehicles, offices, restaurants/bars, schools and stores. Additional model inputs include demographic data for the population being modeled and human activity pattern data from NERL's Consolidated Human Activity Database (CHAD). Model outputs include distributions of PM exposures in various microenvironments (indoors, in vehicles, outdoors) for the population, and the contributions from both PM of ambient origin and indoor sources of PM in these microenvironments. The PM_{2.5} population exposure and microenvironmental concentration distributions predicted by the SHEDS model were compared against measurement data available from a variety of sources including recent EPA-sponsored panel studies. While the data and model predictions were within the same order of magnitude, the comparison led to improvements in the model inputs and algorithms. In addition, the limitations of the measurement data currently available for evaluating population exposure models for PM_{2.5} were also identified. This analysis revealed the need for additional comprehensive exposure studies that include measurements of the temporal variability of microenvironmental PM_{2.5} concentrations and the factors that govern microenvironmental PM_{2.5} exposures in order to fully evaluate these types of population exposure models. This abstract has been reviewed in accordance with the U.S. Environmental Protection Agency's peer and administrative review policies and approved for presentation and publication. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

Shreffler, J.H. Data from a solar ultraviolet monitoring network. Presented at: Department of Statistics, Chapel Hill, NC, January 22, 2001.

1/22/2001

Contact: Jack H. Shreffler

Abstract: The U.S. Environmental Protection Agency, in conjunction with the National Park Service, operates a network of 21 spectrophotometers, measuring spectrally-resolved, surface UV radiation of wavelengths 290-363 nanometers. Fourteen of the measurement sites are in National Parks, and the other seven are in urban areas. A thin layer of ozone, principally in the stratosphere, absorbs much of the short wavelength UV (<320 nm) from the sun and protects life on the surface of the earth. Some very stable man-made chlorine compounds (e.g. refrigerants) have the potential to erode the ozone layer, and this deleterious effect may have been seen most dramatically over Antarctica (the "ozone hole"). This presentation will introduce fundamental concepts concerning ultraviolet radiation and the earth's ozone layer (with potential application to your next beach vacation). Data from the UV network will be presented, as well as measurements of column ozone from satellites. The calibration and operational characteristics of the spectrophotometer will be discussed. An intended objective is to show the wisdom of fully understanding instruments and measurements before launching into a statistical analysis. The possibility of detection of a trend in UV will be addressed. This abstract covers an invited talk by the author to be given January 22, 2001 at the Department of Statistics, University of North Carolina, Chapel Hill. The material in the abstract may be used in the announcement material at UNC.

Jan 1, 2001 - Dec 31, 2001

Presented Published

Swartz, E.C., Stockburger, L., and Gundel, L.A. Characterization of ambient aerosols at Laporte, Texas during TEXAQS-2000. Presented at: American Association for Aerosol Research, Portland, OR, October 15-19, 2001.

10/15/2001

Contact: Leonard Stockburger

Abstract:

Swartz, E.C., Stockburger, L., and Gundel, L.A. Recovery of semi-volatile organic compounds during sample preparation: implications for characterization of airborne particulate matter. Presented at: American Association for Aerosol Research, Portland, OR, October 15-19, 2001.

10/15/2001

Contact: Leonard Stockburger

Abstract:

Zartarian, V. Summary of state-of-science and practice regarding micro-activity data. Presented at: Workshop on Micro/Macro-Activity Data Needs to Improve Multi-Media, Multi-Pathway Exposure/Intake Dose Assessments, Research Triangle Park, NC, May 17-18, 2001.

5/17/2001

Contact: Valerie G. Zartarian morrison

Abstract:

Swartz, E.C., Stockburger, L., and Gundel, L.A. Recovery of semi-volatile organic compounds during sample preparation: implications for characterization of airborne particulate matter. Presented at: Gordon Conference on Atmospheric Chemistry, Newport, RI, June 17-22, 2001.

6/17/2001

Contact: Leonard Stockburger

Abstract:

Zartarian, V., Ozkaynak, H., and Xue, J. Quantifying aggregate chlorpyrifos exposure and dose to children using a physically-based two-stage Monte Carlo probabilistic model. Presented at: 11th Annual Meeting of the International Society of Exposure Analysis, Charleston, SC, November 4-8, 2001.

11/4/2001

Contact: Valerie G. Zartarian morrison

Abstract:

To help address the Food Quality Protection Act of 1996, a physically-based, two-stage Monte Carlo probabilistic model has been developed to quantify and analyze aggregate exposure and dose to pesticides via multiple routes and pathways. To illustrate model capabilities and identify data needs, a case study for young children and chlorpyrifos was conducted. Three post-application time periods (<1, 1-7, 8-30 days) were considered for indoor residential crack and crevice applications and outdoor liquid and granular turf applications. Inhalation, dietary ingestion, dermal contact, and non-dietary ingestion routes were considered for a population of children simulated using time-location-activity diaries from the National Human Activity Pattern survey. Model outputs include graphical and tabular displays of: individuals' route-specific and aggregate daily exposure and dose profiles of exposure, absorbed dose, and eliminated dose; route-specific and aggregate population distributions; contributions to population absorbed dose by route and pathway; uncertainty analyses for the modeled populations; and sensitivity analyses reporting model inputs contributing most to variability. The case study results indicate that dermal contact and non-dietary ingestion are the most important routes for shorter post-application time periods (<7 days), while inhalation and dietary ingestion are important for longer time periods post-application (>7 days). Despite current data limitations and model assumptions, the case study predicts exposure and dose estimates that compare well to measurement studies, and provides insights to the relative importance of exposure routes and model inputs. This work has been funded wholly by the United States Environmental Protection Agency. It has been subjected to Agency review and approved for publication.

Jan 1, 2001 - Dec 31, 2001

Presented Published

11/4/2001

Zartarian, V., Ozkaynak, H., and Xue, J. Assessing residential exposure using the stochastic human exposure and dose simulation (SHEDS) model. Presented at: 11th Annual Meeting of the International Society of Exposure Analysis, Charleston, SC, November 4-8, 2001.

Contact: Valerie G. Zartarian morrison

Abstract: As part of a workshop sponsored by the Environmental Protection Agency's Office of Research and Development and Office of Pesticide Programs, the Aggregate Stochastic Human Exposure and Dose Simulation (SHEDS) Model was used to assess potential aggregate residential pesticide exposures for pesticide products that could be used indoors (crack and crevice scenarios) and outdoors (lawn and vegetable garden scenarios). The scenarios simulated for the workshop address applicator and post-application exposures and absorbed doses, via the inhalation, dermal and oral routes, for adults and children to two anonymous pesticides over various toxicologically relevant time frames (e.g., acute, short-term, and intermediate post-application times; and seasonal and annual averages). Using a 2-stage Monte Carlo simulation approach, SHEDS predicts distributions of both variability and uncertainty for the entire US population and for the sub-population living in homes where pesticides are used. Model outputs include: individuals' route-specific and aggregate exposure and dose profiles (daily and annual) of exposure, absorbed dose, and eliminated dose; route-specific and aggregate population boxplots and cumulative density functions (cdfs); pie charts indicating contributions to population absorbed dose by route and pathway; uncertainty analyses for the modeled populations; and sensitivity analyses reporting significant model inputs. This case study allows for prioritization of data needs to improve and apply aggregate exposure models, comparison of route- and pathway- specific doses, and identification of strengths and limitations of the SHEDS model for predicting adults' and childrens' exposures to pesticides. This work has been funded wholly by the United States Environmental Protection Agency. It has been subjected to Agency review and approved for publication.

Jan 1, 2001 - Dec 31, 2001

Presented Published

11/4/2001

Hore, P., Zartarian, V., Xue, J., Ozkaynak, H., Barr, D., Needham, L., Freeman, N.C.G., Roy, A., and Lioy, P.J. Comparison of field measurements from a children's pesticide study against predictions from a physically based probabilistic model for estimating children's residential exposure and dose to chlorpyrifos. Presented at: 11th Annual Meeting of the International Society of Exposure Analysis, Charleston, SC, November 4-8, 2001.

Contact: Valerie G. Zartarian morrison

Abstract: Semi-volatile pesticides, such as chlorpyrifos, can move about within a home environment after an application due to physical/chemical processes, resulting in concentration loadings in and on objects and surfaces. Children can be particularly susceptible to the effects of pesticides as they are still developing; consequently, it is useful to quantify children's exposure to a semi-volatile pesticide over time in a home environment post-application. Given the difficulties in quantifying aggregate exposure of children to pesticides in a home environment, models for predicting exposure can be employed using field collected data on activity patterns, environmental concentrations, exposure and dose. A physically-based-probabilistic-model referred to as the Residential Stochastic Human Exposure and Dose Simulation (Residential-SHEDS) model for pesticides has been developed by EPA's National Exposure Research Laboratory to help estimate children's aggregate exposure and dose to pesticides in the residential environment via dermal and non-dietary ingestion exposure routes. It is the intent of this paper to compare the results of a children's pesticide study with the estimates made by the Residential-SHEDS model. Data gathered in New Jersey during the Children's Post-Pesticide Application Exposure Study (CPPAES) provides a unique set of results on micro-environmental and biological marker samples that are coupled with macro-and micro-activity data on individual children in homes. Residences with a child between the ages of 2-5 and that routinely apply pesticides were selected for CPPAES. On day-0, a crack and crevice application of chlorpyrifos was made by a licensed applicator to each home. Following the application, pesticide measurements were made on the indoor air and dust for a two-week period post-application (Days 1,2,3,5,7,9,11 post-application). Toys can act as potential sinks within homes and are accessible to the children. Therefore, indicator toys that were placed within the homes following the application were collected sequentially throughout the sampling period and analyzed for their concentration of chlorpyrifos. Direct handrinse and handwipe samples were also collected from the children on each of the sampling days along with detailed records of the child's daily activities through the use of activity questionnaires. Furthermore, videotaped records of each child provided individual hand-to-mouth/object-to-mouth frequency data. Finally, urine samples were collected from the children each day and were analyzed for the chlorpyrifos metabolite. Results indicated that chlorpyrifos is present in the indoor environment throughout the sampling period. Levels in the air ranged from 43.0-351.4-ng m-3 reaching peak levels between days 0-2. Dust wipe concentrations ranged from 0.4-24.3-ng cm-2 with higher levels on days 1,2, and 3. Chlorpyrifos levels in the toys ranged from 245-966-ng/toy. Handrinse levels ranged from 0.23-7.08-ng cm-2. The micro-and macro-activity data and environmental concentrations described above are being used along with extant exposure factor data as input to the Residential-SHEDS model. The resulting model predictions compared against biomonitoring results described above will be presented. This work has been funded in part by the United States Environmental Protection Agency under an EPA Technical Services Contract (Contract No. 0D-5227-NAEX) to the Environmental and Occupational Health Sciences Institute. It has been subjected to Agency review and approved for presentation and publication. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

Swartz, E.C., Stockburger, L., and Gundel, L.A. Characterization of ambient particles at LaPorte, TX, during TEXAQs-2000. Presented at: Texas 2000 Air Quality Study (TexAQs 2000) Science Team Meeting, Austin, TX, August 6-11, 2001.

8/6/2001

Contact: Leonard Stockburger

Abstract:

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9/27/2001

Ozkaynak, H., Zartarian, V., Xue, J., Furtaw, Jr., E.J., and Rigas, M.L. Modeling exposures to pesticides approaches and modeling needs. Presented at: Workshop on Exposure of Children to Pesticides, Berlin, Germany, September 27-29, 2001.

Contact: Haluk Ozkaynak

Abstract: Estimation of exposures of children to pesticides requires careful consideration of sources and concentrations of pesticides that may be present in different environmental media and in foods and beverages consumed by children, as well as the different routes and pathways of exposures specific to daily activities of children of different ages. In recent years a number of (aggregate) exposure models has been developed by various researchers to account for exposures to a single chemical from different routes and pathways. Cumulative exposure models, dealing with aggregate exposures to more than one chemical are, however, still mostly in the developmental stage. The EPA's Office of Research and Development (ORD), National Exposure Research Laboratory (NERL) has developed a probabilistic model (Stochastic Human Exposure and Dose Simulation Model, or SHEDS) that predicts the range and distribution of aggregate personal exposures and doses within a population as well as the uncertainty in the model estimates. The model framework is being developed with an initial case study for the pesticide chlorpyrifos and the population of young children. At the present, the SHEDS model includes the inhalation and dietary ingestion routes in addition to dermal contact and non-dietary ingestion. The model can simulate an individual's exposure up to a year time frame, accounting for multiple pesticide applications in the residential environment, in addition to single day estimates for different post-application time periods. In addition, a user-friendly interface has been developed for the aggregate SHEDS-Pesticides model with both exposure researchers and regulators in mind as potential users. Future versions of the SHEDS model will include more complete characterization of pesticide dose and metabolite concentrations in the body by coupling SHEDS to NERL's Exposure Related Dose Estimating Model (ERDEM). SHEDS and other aggregate or cumulative pesticide exposure models need rigorous evaluation and independent verification against carefully designed field studies. All of the models suffer from limitations of available input information on critical exposure factors for infants and young children, especially dermal and non-dietary transfer efficiencies or coefficients by activity type, location, surface and contact characteristics. In general, models need to demonstrate, by sensitivity analysis, which inputs or parameters are of special concern for future revisions. This information will in turn assist the design of future field exposure and biomonitoring studies that will then generate the critical data necessary for refining the existing pesticide exposure models. In order to develop more robust models with more complete input data, repeated or longitudinal pesticide concentration measurements, time-activity data, and frequency of pesticide usage information in homes, day care centers and schools are also needed. Finally, the form of model outputs that are most useful to regulatory and scientific agencies and the public also needs to be identified. This work has been funded wholly by the United States Environmental Protection Agency. It has been subjected to Agency review and approved for publication.

Swartz, E.C., Stockburger, L., and Gundel, L.A. Recovery of semi-volatile organic compounds during sample preparation: implications for characterization of airborne particulate matter. Presented at: Texas 2000 Air Quality Study (TexAQ5 2000) Science Team Meeting, Austin, TX, August 6-11, 2001.

8/6/2001

Contact: Leonard Stockburger

Abstract:

Berkley, R.E., Akard, M.L., Oliver, K.D., Jacumin, Jr., H.H., and Gardner, B.D. High speed GC/MS for air analysis. Presented at: Pittsburgh Conference on Analytical Chemistry and Applied Spectroscopy, New Orleans, LA, March 4-9, 2001.

3/4/2001

Contact: Richard E. Berkley

Abstract: A high speed GC/MS system consisting of a gas chromatograph equipped with a narrow bandwidth injection accessory and using a time-of-flight mass spectrometer detector has been adapted for analysis of ambient whole air samples which have been collected in passivated canisters. Commercially-available system components were used throughout. Turn-around time has been reduced by a factor of ten compared with EPA Method TO-14, and data are processed concurrently with sample analysis. Detection limits compared for both methods. Instrument configuration and control are described. Data from samples analyzed by both high speed GC/MS and Method TO-14 are compared. The information in this document has been funded wholly or in part by the United States Environmental Protection Agency. It has been subjected to Agency review and approved for publication. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

Jan 1, 2001 - Dec 31, 2001

Presented Published

Berkley, R.E., Oliver, K.D., Jacumin, Jr., H.H., Ebersold, P., and Budd, T. Comparison of fast GC/TOFMS with method TO-14 for analysis of ambient air samples. Presented at: Ninth International Conference On-Site Analysis, Amelia Island, FL, January 21-24, 2000.

1/21/2001

Contact: Richard E. Berkley

Abstract: Field studies using portable gas chromatographs (PGC) to analyze volatile organic compounds in ambient air usually include, as reference standard method, the analysis of concurrent, collocated canister samples by EPA Method TO-14. Each laboratory analysis takes about an hour and is followed by lengthy data verification. Reference standard data often do not appear before the end of a field study. Fast gas chromatography (FGC) can perform the same analyses much faster and offers the possibility of using reference standard data to influence the conduct of the study. A fast GC system composed of commercially-available components was operated in the role of reference standard method during a field study conducted in Research Triangle Park, NC. Field analyses were done with PerkinElmer Voyager[®] PGCs. Canister grab samples collected simultaneously were analyzed by an FGC system composed of an Agilent Technologies 6890[®] gas chromatograph equipped with a Chromatofast GC Accelerator[®] narrow-bandwidth injector and a Leco Pegasus II[®] time-of-flight mass spectrometer detector. It could process whole-air canister samples about ten times faster than conventional EPA Method TO-14. Canister samples were also analyzed by conventional Method TO-14 and data were compared. This work has been funded wholly or in part by the United States Environmental Protection Agency under contract no. 68-D5-0049 to ManTech Environmental Services Inc. It has been subjected to Agency review and approved for publication. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

Noble, C.A., Murdoch, R.W., Natarajan, S., Vanderpool, R.W., Gemmill, D.B., and Wiener, R.W. Field evaluation of a sampling approach for PM-coarse aerosols. Presented at: American Association for Aerosol Research, Portland, OR, October 15-19, 2001.

10/15/2001

Contact: Elizabeth T. Hunike

Abstract: Subsequent to a 1997 revision of the national ambient air quality standards (NAAQS) for particulate matter (PM), the US Environmental Protection Agency is investigating the development of sampling methodology for a possible new coarse particle standard. When developed, this method will measure the mass concentration of particles in the size range of 2.5-10 μm in diameter. Although the PM-coarse measurement methodology has yet to be finalized, a numerical difference method between collocated PM₁₀ and PM_{2.5} samplers is being considered. To investigate the feasibility of the difference method for PM-coarse measurement, field studies were conducted at Research Triangle Park, NC, Rubidoux, CA, Phoenix, AZ, Philadelphia, PA, and Windsor, CT. These five sites provided a broad range of chemically and physically diverse ambient PM. Each of the five field campaigns consisted of fifteen consecutive days of sampling. At each site, three pairs of PM₁₀ and PM_{2.5} samplers were collocated, with each pair being from a different manufacturer. Refrigerated samples were sent back to the laboratory for gravimetric analysis after every fifth sampling day. As expected, Rubidoux and Phoenix had the highest concentration measurements of PM-coarse. Ambient concentrations for coarse PM ranged from 2 μg per cubic meter in Windsor, to 59 μg per cubic meter in Rubidoux for single day measurements. The relative contribution of coarse PM to the PM₁₀ measurements was greatest in Rubidoux and Phoenix, where there were relatively high amounts of airborne crustal material. The PM_{2.5}/PM₁₀ ratio ranged from 0.22 at Phoenix to 0.70 at Philadelphia. These field studies demonstrated that a subtraction method utilizing results from independent PM₁₀ and PM_{2.5} sampling devices provide results with an acceptable level of precision. As expressed by the coefficient of variation, mean precision at the five sites for PM₁₀, PM_{2.5}, and PM-coarse were approximately 5%, 3%, and 9%, respectively. This abstract has been subjected to Agency review and approved for publication. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

Jan 1, 2001 - Dec 31, 2001

Presented Published

Heist, D.K., Eisner, A.D., Mitchell, W.J., and Wiener, R.W. The use of box models to describe the personal cloud effect on human exposure to particulate matter. Presented at: American Association for Aerosol Research, Portland, OR, October 15-19, 2001.

10/15/2001

Contact: William J. Mitchell

Abstract: An algorithm has been developed to describe particle transport into and out of the breathing zone in an effort to predict the effects of the personal cloud phenomenon (Eisner and Heist, 2000). The algorithm was developed based on the principle of mass balance between a system of well-mixed zones (or boxes) with flow between them. The algorithm was used to model breathing-zone concentrations around a child-size manikin used in wind tunnel experiments. We propose a three-box model, where the smallest of the boxes represents a local source of particulate matter, the medium-size box represents a personal cloud space, and the largest box represents the rest of the room. By dividing the volume of a room into three sub-volumes, each characterized by a specific airflow through it, we can limit the assumption of the well-mixed conditions to a much smaller volume, thus improving overall model performance. Experimental measurements of air velocity and aerosol concentration around a child-size manikin have been used to estimate the parameters used in the algorithm. The size of the boxes depends on the flow patterns around the body and vary depending on the simulated conditions in the wind tunnel. The flow rates between the boxes were estimated from the velocity field measurements. The source characteristics were obtained from experiments with pre-loaded surfaces. The algorithm has been tested with data produced from a wind tunnel experiment where a floor level release of aerosol was entrained into the breathing zone by the natural convection caused by the manikin's simulated body heat. Initial model results compare favorably with the experimental results. The reliability of the algorithm is also being verified in unsteady conditions through comparison with laboratory data. This abstract has been subjected to Agency review and approved for publication. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

Richmond-Bryant, J., Eisner, A.D., Heist, D.K., Mitchell, W.J., and Wiener, R.W. New versatile aerosol generation system developed for use in a large wind tunnel. Presented at: American Association for Aerosol Research, Portland, OR, October 15-19, 2001.

10/15/2001

Contact: Elizabeth T. Hunike

Abstract: A new aerosol generation system was developed to accommodate a variety of research activities performed within a large wind tunnel. Because many of the velocity measurements are taken in the wind tunnel with a laser Doppler anemometer (LDA), it is necessary to maintain an aerosol concentration which is high enough to prevent velocity bias while low enough to sustain sample independence. Furthermore, concentration uniformity within 10% in the vicinity of a measurement is a requirement for fulfilling the U.S. EPA criteria for testing PM10 samplers in a wind tunnel. The aerosol generation system utilizes an array of venturi nozzles to seed the test section in a uniform manner. An in-house compressed air supply passes through a regulator and a filtration system before being divided into five air lines. At the end of each air line is an in-line corona discharge device (Meech, Inc., Model 940, Richland, OH). Following the corona discharge device, each of the five air lines is divided into two lines. These air lines then connect to the ten venturi nozzles which are arranged in four horizontal rows. The high-pressure compressed air fed through the back of the venturi nozzles creates a vacuum in the port at the bottom of the nozzle. Here, a brass tube carries solid ceramic particulate matter (3M Zeeospheres TM, St. Paul, MN) from a 0.13-m wide conveyor belt with a variable-speed motor (mk Automation Engineering, Inc., Series 2000, Simsbury, CT). The rough texture of the conveyor belt allows for more material to be held by the belt prior to suction. Particles are loaded onto the belt with a gravity-feed hopper located directly over one end of the belt. In addition to the uniform concentration distribution, a stratified distribution was created in the tunnel by disabling the suction tubes for all but the three lowest venturi nozzles by lifting them off of the conveyor belt. Spatial uniformity of the aerosol concentration across the test section of the wind tunnel was tested using isokinetic sampling. It was found for the conditions tested within the wind tunnel that uniformity could be achieved within a coefficient of variation of 6.4%. For these tests, concentration levels remained high, on the order of 10 mg/m³. Reconfiguration of the nozzles demonstrated that the system could also be used to attain a stratified particle loading, with a fifteen-fold average difference in concentration above and below the 10 cm transition region. This abstract has been subjected to Agency review and approved for publication. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

Jan 1, 2001 - Dec 31, 2001

Presented Published

Berkley, R.E., Akard, M.L., Oliver, K.D., Jacumin, Jr., H.H., and Gardner, B.D. High-speed GC/MS for air analysis. Presented at: Federation of Analytical Chemistry and Spectroscopy Societies, Detroit, MI, October 7-12, 2001.

10/7/2001

Contact: Richard E. Berkley

Abstract: High speed or fast gas chromatography (FGC) consists of narrow bandwidth injection into a high-speed carrier gas stream passing through a short column leading to a fast detector. Many attempts have been made to demonstrate FGC, but until recently no practical method for routine analyses had been realized. Adequate columns have been available, but performing consistent narrow-bandwidth injections has been problematic. Also, few versatile detectors fast enough to trace narrow peaks have been available. We report here a procedure that performs analyses of EPA Method TO-14 target list compounds at a rate ten times faster than standard Method TO-14 with similar data quality. A chromatofast GC Accelerator was used to perform injections into a 16m x 0.25 mm DB-1 column in an Agilent Technologies 6890 chromatograph equipped with fast temperature programming and pressure programming capability. A helium carrier flow rate of 5ml/min was used. The detector was a Leco Pegasus II time-of-flight mass spectrometer. The GC Accelerator cryotrapped the sample in an open tube which was then backflushed while being heated with a capacitive discharge at an estimated rate of 100,000C /s. The Pegasus II can record up to 500 full mass spectra per second but was operated at only 50 mass spectra per second. Chromatograms of 2min duration adequately separated all of the TO-14 target list compounds well enough that the Pegasus II data processing algorithm could correctly identify and quantitate them. Data processing was performed in the background during data acquisition. Linearity of response to changing sample volumes and changing sample concentrations was demonstrated. A group of ambient air samples was analyzed repeatedly by both standard Method TO-14 and fast GCMS, and data from both methods were in close agreement. This work has been funded wholly or in part by the United States Environmental Protection Agency under Contract No. 68D00206 to Man Tech Environmental Technology. It has been subjected to Agency review and approved for publication. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

Willis, R.D., Ellenson, W.D., and Conner, T.L. Identification of FMC emission sources contributing to ambient PM10 on the Fort Hall reservation. Presented at: Pacific Northwest Tribal Air Network Quarterly Meeting, Pocatello, ID, August 9-10, 2001.

8/9/2001

Contact: Teri L. Conner

Abstract:

McClenny, W.A., Oliver, K.D., Jacumin, Jr., H.H., and Daughtrey, Jr., E.H. Ambient VOC monitoring using solid adsorbents - NERL, U.S. EPA. Presented at: International Symposium on Thermal Desorption for Occupational, Medicinal, and Environmental Chemical Analysis, Birmingham, AL, October 9-10, 2001.

10/9/2001

Contact: William A. McClenny

Abstract:

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3/15/2001

Cole, D., Sobsey, M.D., Bumgarner, J.E., and Robinette, D. Antimicrobial resistance among enteric bacteria isolated from human and animal wastes and impacted surface waters: comparison with NARMS findings. Presented at: National Antimicrobial Resistance Monitoring System Meeting, Rockville, MD, March 15-16, 2001.

Contact: Myriam Medina-vera

Abstract: Human infection with bacteria exhibiting mono or multiple antimicrobial resistance (MAR) has been a growing problem in the US, and studies have implicated livestock as a source of MAR bacteria primarily through foodborne transmission routes. However, waterborne transmission of resistant microbes and transferable genetic elements via fecal contaminated waters is another postulated route of MAR transmission from livestock to humans. Human acquisition of MAR pathogens or transferable genetic elements from animal feeding operation (AFO)-contaminated water can occur either through direct intake of resistant microbes in drinking or recreational waters, or by ingestion of resistant microbes on produce irrigated with AFO-contaminated waters. An ongoing study of 2 cattle farms, 2 swine farms, and 2 human waste water treatment facilities in North Carolina is collecting isolates of *E. coli*, enterococci, and *Salmonella* from cattle, geese, and swine wastes; cattle and swine waste lagoons; partially treated human waste; and surface waters adjacent to study farms and in rural/background surface waters. The MIC of each isolate to a variety of human and animal antimicrobials is determined using a customized Sensititre (SensititreTM, TREKTM Diagnostics, Inc.) plate and compared to the breakpoints used in the National Antimicrobial Resistance Monitoring System (NARMS) surveillance study. The most common resistance patterns found among both human and animal waste-derived *E. coli* isolates include streptomycin, sulfamethoxazole, and ampicillin. Tetracycline resistance was found among >90% of swine *E. coli* isolates and 50% of bovine isolates but has not been observed among the human *E. coli* isolates so far. Conversely, 29% of human *E. coli* isolates exhibited resistance to trimethoprim compared to none of the swine or cattle isolates. Similar resistance patterns are found among the *Salmonella* isolates. Three human *Salmonella* isolates (21%) were susceptible to all tested antimicrobials; whereas only 1 swine *Salmonella* isolate (4%) was susceptible to all tested antimicrobials. MAR patterns were prevalent among both human (42% MAR) and swine (75% MAR) *Salmonella* isolates. Resistance to erythromycin and tetracycline was more commonly observed among the swine enterococcal isolates (100% for both) compared to human isolates (40% and 20%, respectively). The prevalence of resistance is slightly higher among isolates obtained from animal waste lagoons than from barn flush, and the patterns observed among resident geese reflect those observed in the swine wastes. In addition, bacterial isolates from surface water sites located downstream from swine farms have higher prevalences of resistance than those obtained from upstream sites and the observed resistance patterns are similar to those observed among farm isolates. Furthermore, the most prevalent resistance patterns observed among downstream *E. coli* isolates are those reported by NARMS as being most prevalent among clinical *E. coli* O157 isolates. Although the results are preliminary, these data suggest that waterborne transmission may be another route of human exposure to resistant microbes of livestock origin. This work has been funded wholly or in part by the United States Environmental Protection Agency under OD-5555-NTEX to the University of North Carolina (UNC). It has been subjected to Agency review and approved for publication.

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7/29/2001

Falconer, R.L., Morgan, M.K., Garrison, A.W., Leone, A.D., Bidleman, T., and Jantunen, L.M.
Chiral pesticides: occurrence and significance. Presented at: Rocky Mountain Conference on Analytical Chemistry, Denver, CO, July 29-August 2, 2001.

Contact: Renee L. Falconer

Abstract: Like amino acids, certain pesticides exist in "left-handed" and "right-handed" (chiral) forms. Commercially available chiral pesticides are produced as racemic mixtures in which the ratio of the two forms (or enantiomers) is 1:1. Enantiomers have the same physical and chemical properties, therefore transport processes (leaching, volatilization) and abiotic reactions (hydrolysis, photolysis) do not discriminate between the enantiomers. However, since enzymes themselves are chiral molecules, they can react selectively with one of the forms. Thus, metabolism by microorganisms in water and soil and in higher organisms often leads to non-racemic residues. Examining the enantiomeric patterns of pesticides thus provides a sensitive indicator of biological degradation. Several classes of insecticides and herbicides have members that are chiral, including four of the eight OC pesticides on the United Nations Environmental Program list (o,p'-DDT, chlordane, heptachlor and toxaphene). Pesticide enantiomers have been separated by gas and liquid chromatography and capillary electrophoresis. With GC-MS, it is possible to determine the fraction of enantiomers within 1-2% relative standard deviation or less, more precisely than individual concentrations. Numerous studies have been done looking at chiral pesticides and their metabolites in the environment and several researchers have reported preferential degradation/accumulation of pesticide enantiomers in biota. Unfortunately, very little work has been done to date on chiral pesticides in the human body even though past research has shown that enantiomers of biologically active chiral molecules can differ in potency, pharmacological action, metabolism, toxicity and kinetics. In our current work, we are studying the enantiomeric patterns of chiral pesticides and their chiral metabolites in human breast milk and adipose tissue as well as in ambient and indoor media. This work has been funded wholly or in part by the United States Environmental Protection Agency and has been subjected to Agency review and approved for publication.

Holterman, A.L., and Pleil, J.D. A non-invasive diagnosis of intestinal ischemia by exhaled breath analysis using gas chromatography and mass spectrometry-preliminary results. Presented at: American Pediatric Surgical Association Meeting, Naples, FL, May 20-23, 2001.

5/20/2001

Contact: Joachim D. Pleil

Abstract: To explore the potential of exhaled breath analysis by Column Chromatography-Mass Spectrometry (GC-MS) as a non invasive and sensitive approach to evaluate mesenteric ischemia in pigs. Domestic pigs (n=3) were anesthetized with Guaifenesin/ Fentanyl/ Ketamine/ Xylazine drip and ventilated with compressed air. Intestinal ischemia was induced by ligation of the proximal superior mesentery artery. Mean arterial pressure (MAP), body temperature, heart rate (HR), arterial blood gas, urine output were monitored. Markers for ischemia were assessed with serum Phosphate, Creatine Kinase (CK) enzymes, base excess (BE) and full thickness intestinal biopsies. A sampling device triggered by exhaled breath temperature is used to collect primarily exhaled alveolar breath. Breath samples were harvested into SUMMA stainless steel canisters (1 Liter) at 0 and 3 hours of arterial occlusion and after reperfusion for analysis. Polar and non-polar volatile organic compounds (VOCs) in the breath were analyzed with cryogenic preconcentration followed by GC-MS detection. Quantification of relative amounts of VOCs was achieved with normalization to breath CO₂ content. Data were tested for statistical significance using the two-tailed t test. Biopsies samples confirmed mucosal necrosis at 3 hours of arterial occlusion. There were no significant differences in MAP (83+/-8 and 70+/- 32), HR (83+/- 2 and 76+/-30), base deficit (-1 +/- 5 and ?2 +/- 5), serum phosphate (6 +/-2 and 6.5 +/- 1) or CK levels (737+/- 79 and 804 +/- 91) between the 0 and 3 hours time points. Canister breath samples indicated marked increases following ischemia in the levels of 2-methyl propanal (26 fold increase at 3 hours, and 190 fold after reperfusion), 2-methyl-butanal (28 and 102) and benzaldehyde (5 and 11). These polar-VOCs are known organic metabolites of lipid peroxidation indicative of oxidative injury. Conclusion: Biochemical markers for ischemia can be identified in exhaled breath early in the course of injury using non invasive breath analysis by GC-MS. The clinical applicability of breath measurement in the diagnosis of extensive mucosal injury (necrotizing enterocolitis, intestinal ischemia, ?) should be further explored. This is an abstract of a proposed presentation and does not necessarily reflect EPA policy.

Jan 1, 2001 - Dec 31, 2001

Presented Published

Troester, M.A., Lindstrom, A.B., and Rappaport, S.M. Investigation of the radical-mediated production of benzene oxide protein adducts in vitro and in vivo. Presented at: Society of Toxicology Meeting, San Francisco, CA, March 25-29, 2001.

3/25/2001

Contact: Andrew B. Lindstrom

Abstract: High background levels of benzene oxide (BO) adducts with hemoglobin and albumin (BO-Hb and BO-Alb) have been measured in unexposed humans and animals. To test the influence of radical-mediated pathways on production of these BO-protein adducts, we employed Fenton chemistry to generate free radicals in vitro. Incubations containing human Hb, ascorbate, and H₂O₂ produced levels of BO-Hb that were approximately 13 times higher than control incubations. Addition of sodium benzoate to these incubations led to even greater levels of BO-Hb while the iron chelator Desferrioxamine (1 mM) diminished production of BO-Hb. Results suggest a radical-mediated pathway for production of BO-Hb in vitro. We then tested the radical-mediated production of BO-protein adducts in vivo by administering a single dose of 0 to 1600 mg of carbon tetrachloride (CCl₄) (a known producer of free radicals in vivo) per kg body weight to 24 male F344 rats, with and without co-exposure to sodium benzoate. Comparison of adduct concentration by dose of CCl₄ using an analysis of variance (ANOVA) procedure suggests that there was no significant increase in the concentration of BO-Alb ($p = 0.576$) or BO-Hb ($p = 0.204$) as a function of CCl₄ dose. Simultaneous treatment with CCl₄ and aqueous sodium benzoate (5 mmol/kg body weight) also failed to significantly increase levels of BO-Alb ($p = 0.167$) or BO-Hb ($p = 0.771$) as a function of CCl₄ dose. Thus, we were unable to demonstrate radical-mediated production of background BO-Alb and BO-Hb in vivo. Supported in part by NIEHS Superfund Basic Research Program Grant P42-ES05948 and in part by the United States Environmental Protection Agency. It has been subjected to U.S. EPA review and approved for publication.

Martin, S.B., Jensen, P.A., and Pleil, J.D. Field-produced JP-8 standard for calibration of lower explosive limit meters used by jet fuel tank maintenance personnel. Presented at: American Industrial Hygiene Conference and Exposition, New Orleans, LA, June 2-7, 2001.

6/2/2001

Contact: Joachim D. Pleil

Abstract: Thousands of military personnel and tens of thousands of civilian workers perform jet fuel tank entry procedures. Before entering the confined space of a jet fuel tank, OSHA regulations (29CFR1910.146) require the internal atmosphere be tested with a calibrated, direct-reading instrument for oxygen content, flammable gases and vapors, and potential toxic air contaminants. These checks are typically done using lower explosive limit (LEL) meters which provide the percent LEL and oxygen level in the atmosphere, and many have other sensors installed (e.g., carbon monoxide, hydrogen sulfide, etc.). Most manufacturers suggest the meters be calibrated using a known methane or pentane standard. However, a previous NIOSH study found that manufacturer-recommended calibration techniques do not match instrument performance when monitoring jet fuel vapors. JP-8 and Jet-A fuels are generally C₉ to C₁₆ compounds. Because most LEL meters are calibrated against n-alkanes less than C₉, some meters may underestimate the explosive potential of jet fuel vapor in the tanks after removal of the most volatile components. Also, maintaining a stock of pure calibration gases can be troublesome, particularly in the case of military deployments. In this study, liquid jet fuel was introduced into tedlar bags and the atmosphere inside the bag allowed to equilibrate. Once equilibrated, the concentration of the jet fuel vapors can be easily calculated using the ambient temperature and known vapor pressure vs. temperature curves. Furthermore, the vapor concentration can be controlled by temperature. Thus, actual jet fuel calibration standards can easily and routinely be produced in the field and used to calibrate LEL meters. Comparing the performance of various LEL meters and a Foxboro TVA 1000B, with flame-ionization detector, calibrated per manufacturer instructions and using the field-developed standards shows the field-produced standards work very well for the calibration of LEL meters. This is an abstract of a proposed presentation and does not necessarily reflect EPA policy.

Jan 1, 2001 - Dec 31, 2001

Presented Published

6/22/2001

Lindstrom, A.B., and Pleil, J.D. Alveolar breath sampling and analysis in human exposure assessment studies. Presented at: NATO Advanced Study Institute Conference "Disease Markers in Exhaled Breath: Basic Mechanisms and Clinical Applications", Crete, Greece, June 22-July 1, 2001.

Contact: Andrew B. Lindstrom

Abstract: Alveolar breath sampling and analysis can be extremely useful in exposure assessment studies involving volatile organic compounds (VOCs). Over recent years scientists from the EPA's National Exposure Research Laboratory have developed and refined an alveolar breath collection and analysis technique that has been applied in a wide range of investigations. This lecture covers the development of this breath collection technique in the laboratory and the application of this methodology in a range of field studies. This work demonstrates how exhaled breath analysis can be used to clearly demonstrate recent exposures to VOCs, to determine compound-specific elimination kinetics, and to assess the relative importance of each exposure route (i.e., dermal, ingestion, inhalation). Previously published studies to be reviewed demonstrating the use of breath sampling include: an assessment of exposures related to the residential use of contaminated groundwater; exposures to gasoline and fuel additives at self-service gas stations; swimmers' exposures to trihalomethanes; route-specific exposure analysis involving methyl tertiary-butyl ether; and occupational exposures to jet fuel vapors. Techniques of breath collection and analysis will be reviewed in this context. Further potential application of these techniques in related studies will be discussed. This work has been funded wholly by the United States Environmental Protection Agency. It has been subjected to Agency review and approved for publication.

Jan 1, 2001 - Dec 31, 2001

Presented Published

4/1/2001

Medina-Vera, M., Wright, L.H., and Lumpkin, M.S. Methods for the analysis of alkylphenol ethoxylates and derivatives. Presented at: American Chemical Society 221st National Meeting, San Diego, CA, April 1-5, 2001.

Contact: Myriam Medina-vera

Abstract:

Alkylphenol ethoxylates and their derivatives are well known for their harmful impact in wildlife. These compounds are being phased-out and banned in most European Countries. Their use has increased in the U.S. resulting in their addition to the Priority Testing List, TSCA (1997). The compounds are used in pulp and paper manufacturing, textiles manufacturing, plastic and elastomer manufacturing (e.g. nonylphenol in the form of tris-nonylphenol phosphite, octylphenol), household, industrial and institutional cleaning (e.g. Triton X-100), oil extraction and production, agriculture (as adjuvants for active ingredients in pesticides), metal processing, paint and protective coating, leather manufacturing, building and construction, food and beverages sectors, and as spermicides in contraceptive foams, jellies and creams (e.g. nonoxonyl-9). Alkylphenol ethoxylates are partially degraded in sewage treatment plants. The main degradation products formed in sewage treatment plants or in rivers are alkylphenol ethoxylates with fewer ethoxylate groups, alkylphenoxy carboxylic acids and alkylphenols.

Studies suggest that these compounds persist in rivers, sediment and groundwater (1-3). Alkylphenol like compounds are also concentrated by organisms (4) such as fish and birds. The objective of this work is to compile and develop analytical methods for the characterization and quantitation of alkylphenol ethoxylates, alkylphenols and derivatives in several environmental matrices. To adequately understand pathways of exposure, fate & transport of alkylphenol ethoxylates and their derivatives, it is necessary to characterize exposure accurately. This can only be done by using valid methods that are sensitive and reliable. It is already known that some data gaps exist for alkylphenols ethoxylates, alkylphenols, and their carboxylic derivatives in water, sediment and biota. Alkylphenol ethoxylates can be released to the environment through wastewater treatment systems and agricultural runoff. Most analytical efforts focus on the analysis of alkylphenols exclusively without considering the need for quantitating the ethoxylates and carboxylic components. The breakdown products of alkylphenols ethoxylates are generally ten times more toxic (e.g. Daphnia) than the original compounds. In the United Kingdom, alkylphenols ethoxylates are believed to be mainly responsible for the production of female egg-yolk protein on the male Rainbow Trout. Compounds such as nonylphenoxy acetic acid have been confirmed to affect the hormonal control in adult male trout. Research shows that these compounds persist in rivers, sediments and groundwater and that they can be accumulated by fish and birds. The measurement of these compounds has become such an important issue that countries like Denmark have set water quality criterion for nonylphenol and nonylphenol ethoxylates. These compounds have been found to be estrogen mimickers. Humans are exposed directly to them through contaminated waters, absorption through the skin from shampoos, spermicidal lubricants, etc, and by inhalation and ingestion of pesticide sprays, and contaminated food. To assess the exposure to these compounds a multimedia approach which measures degradation products of alkylphenol ethoxylates is necessary. Preparation of standards Nonyl and t-octylphenol and mixtures of their polyethoxylate homologs were obtained from commercial sources. No commercial source could be located for the alkylphenol polyethoxylate carboxylates, which result from oxidation of the terminal oxyethanol unit. These derivatives were obtained via custom synthesis (Organix, Inc., Woburn, Mass., and Gateway Chemical Technology, St. Louis, Mo.). Sample Isolation methods being tested

Solid Phase Extraction cartridges are being used for the extraction of aqueous samples. Fresh water samples are collected from a control site and an agricultural impacted area in the Neuse River Basin. One liter amber bottles are used for the collection. The collected fresh water samples are passed through a conditioned SPE cartridge and eluted with solvent. Several cartridges are being tested. SPE cartridges are conditioned by passing thru High Purity water (2 mL), and then 2 mL of methanol. The samples are eluted by using methanol or acetonitrile. The extract is then analyzed by HPLC. Accelerated Solvent Extraction (ASE) is being used for the extraction of solids. Five grams of dry sediment samples are packed into the ASE cartridge. Sediment samples were collected from the same area as the water samples. The top layer of sediment (4 cm) is sieved, dried, and stored on glass jars (4 OC) before extraction. Several programs are being tested to optimize the extraction. The solvents used include dichloromethane and methanol. Chromatography Both normal and reverse phase HPLC experiments are being conducted using a Hewlett-Packard HP-1090 chromatograph equipped with a diode array detector and a fluorescence detector. Several reverse phase columns were tested. Normal phase experiments were primarily conducted using an Zorbax amine column. Future tests include a HPLC/MS method. CURRENT PROGRESS/DISCUSSION The lack of commercial sources to obtain the necessary standards confirms the lack of analytical methods for alkylphenol ethoxylates. The goals of this methods development effort are 1) reducing solvent use, 2) streamlining sample handling, and 3) simplifying analysis. Chromatographic analyses have been done for nonyl- and t-octylphenol and mixtures of their polyethoxylate homologs. Normal phase chromatography provided better resolution of the homologs than reverse phase chromatography on the basic HPLC/UV/Fluorescence system. HPLC/MS (HP1100) and Capillary electrophoresis (CE 3D) methods are being optimized to improve the resolution and sensitivity. A new promising water sampling technique that combines SPE principles and ASE technology is being tested as a possible method that would reduce sample handling, solvent used, and extraction times.

This work has been reviewed in accordance with the U.S. Environmental Protection Agency's peer and administrative review process and approved for presentation and publication.

Jan 1, 2001 - Dec 31, 2001

Presented Published

Medina-Vera, M. Science careers at EPA: an exciting opportunity to serve. Presented at: NIH Mention of tradenames or commercial products does not constitute endorsement or
1/25/2001
Strategies for Success in Science Seminar Series, Bethesda, MD, January 25, 2001. recommendation for use.

Contact: Myriam Medina-vera

Abstract: The Environmental Protection Agency has 30 years of history protecting the environment and human health. The scientists at EPA have different backgrounds and experiences that contribute to the creativity of research and development of risk assessment techniques. An overview of EPA's ORD organization will be discussed as well as general research areas. A general mission description of ORD labs and centers will be provided. NERL's science research and working opportunities will be highlighted. The presentation includes a general discussion on collaboration, research opportunities, special emphasis programs, and science careers at EPA. The information in this document has been provided by the U.S. Environmental Protection Agency public records, however the presentation does not necessarily reflect the views of the Agency but those of the presenter.

Pleil, J.D., Leavens, TL, Colon, M., Case, M.W., Prah, J.D., and Ashley, D.L. Measurement of exhaled breath and venous blood to develop a physiologically based pharmacokinetic model for human exposure to methyl tertiary-butyl ether and the production of the biomarker tertiary-butyl alcohol. Presented at: Environmental Sampling and Analysis Seminar, Okinawa, Japan, July 8-22, 2001.

7/8/2001

Contact: Joachim D. Pleil

Abstract: Methyl tertiary-butyl ether (MTBE) is a common fuel additive used to increase the availability of oxygen in gasoline to reduce winter-time carbon monoxide emissions from automobiles. Also, MTBE boosts gasoline "octane" rating and, as such, allows reduction of benzene (and other aromatics) content without compromising automobile performance. Two less desirable properties of this additive are that it has a very low odor threshold and that it is highly soluble in water. This solubility poses unique problems when fuel is spilled and enters the water table in that MTBE (in contrast to the less soluble hydrocarbons in fuel) is rapidly dispersed in water and is then very difficult to remove. In addition to the distinctive odor in air and water, MTBE has been identified as an animal carcinogen at high concentrations. There are two primary exposure scenarios for MTBE in the general public: inhalation exposure during self-refueling of automobiles (and/or incidental exposure through accidental dermal contact at the fuel pump), and the use of fuel contaminated water that results in dermal and inhalation exposure during bathing, ingestion exposure from water consumption, and inhalation exposure from volatilization during general water usage. For the purposes of studying MTBE pharmacokinetics in humans, we focused on the water borne pathway because these exposures are more amenable to controlled study. Blood and breath measurements were made before, during, and after controlled inhalation, ingestion or dermal exposure to levels of MTBE similar to high range of typical exposures from contaminated water in certain regions of California. Specifically, we used the following MTBE levels: 3 ppmv in air for 60 minutes for inhalation, one arm in 60 ug/L water for 60 minutes for dermal, and 250 ml at 14 ug/L bolus in Gatorade for ingestion. The resultant data were used to test a pharmacokinetic model developed for these experiments and for MTBE in general. Compartments in the model included alveolar space, arterial and venous blood, brain, fat, gastrointestinal tract, kidney, liver, rapidly perfused tissues, sampled and arms, and slowly perfused tissues. To accurately simulate the clinical human exposure and sampling conditions, the exposed arm and sampled arm were described by subcompartments for arterial blood, upper arm tissue, forearm tissue, forearm skin, antecubital venous blood, and venous blood. Metabolism of MTBE and TBA was assumed to occur only in the liver, and elimination was assumed to occur via exhalation of MTBE and TBA and urinary elimination of TBA. Dermal absorption was described by Fick's law, and oral absorption was described as first order for the bioavailable dose. Initial estimates for parameters were obtained from the literature. The model with the optimized parameters accurately simulated pharmacokinetics of MTBE and TBA in humans for all three routes. Of the inhaled, oral, and dermal doses 54, 47, and 54%, respectively, were exhaled as MTBE, and 44, 52, and 44%, respectively, were metabolized to TBA. This model can now be used to simulate environmental exposure to MTBE. This work has been reviewed in accordance with the U.S. Environmental Protection Agency's peer and administrative review process and approved for presentation and publication. Mention of tradenames or commercial products does not constitute endorsement or recommendation for use.

Jan 1, 2001 - Dec 31, 2001

Presented Published

7/8/2001

Pleil, J.D., Colon, M., and Lindstrom, A.B. New methodology for identifying potential human biomarkers by collection and concentration of exhaled breath condensate. Presented at: Environmental Sampling and Analysis Seminar, Okinawa, Japan, July 8-22, 2001.

Contact: Joachim D. Pleil

Abstract: In many studies of human exposure, the measurement of pollutant chemicals in the environment (air, water, food, soil, etc.) is being supplemented by their additional measurement in biological media such as human breath, blood, and urine. This allows an unambiguous confirmation of the identity and amount of the chemical exposure to the human subject. For volatile organic compounds (gaseous pollutants in air), breath is the simplest choice for the biological matrix because it is easy to get (especially compared to blood), it is easier to analyze trace gases in a gas phase (rather than liquid phase) matrix, and no infectious waste (needles, vials, leftover liquids) are generated. The subsequent success of using breath as a "biological fluid" has created interest in measuring additional compounds that may serve as internally produced biomarkers of external chemical exposures which could serve as a simple, non-invasive exposure assessment tool for internal dose. Such biomarkers will most likely occur at very low concentrations compared to the exposure and will be very water soluble; these are two properties that make gas phase analysis difficult. We have developed a sampling and analytical method that accentuates the water soluble fraction of organic compounds in breath for GC-MS analysis. Multiple breaths are passed through special glassware at subambient temperature (-80C); upon heating to 37C, the condensed water is sparged with dry nitrogen into a standard 1-liter volume breath sampling container (SUMMA canister) also at -80C. When warmed to room temperature, the canister becomes positively pressurized and is then analyzed as a normal single breath sample, yet contains an elevated amount of the polar volatile organic compounds as trapped from 40 or 50 breaths. This allows more detailed analysis of the normally occurring metabolic products as well as putative biomarkers of exposure in breath. To date, we have identified a variety of compounds in normal (healthy) adults that include C3 to C9 n-aldehydes, C3 and C4 branched aldehydes, benzaldehyde, various volatile alcohols including methanol, ethanol, butanol, 1- and 2-propanol, and methyl ethyl ketone. Additionally, variety of ketones, aldehydes, alcohols, terpenoids, ethers, acetates, etc. have been tentatively identified and work continues to unambiguously confirm as many compounds as possible. In the long run, we anticipate using patterns of endogenously produced compounds expressed in breath as an indicator of external exposure. This work has been reviewed in accordance with the U.S. Environmental Protection Agency's peer and administrative review process and approved for presentation and publication. Mention of tradenames or commercial products does not constitute endorsement or recommendation for use.

Jan 1, 2001 - Dec 31, 2001

Presented Published

7/8/2001

Pleil, J.D., and Lindstrom, A.B. A brief history of the development of exposure assessment methods at US EPA/NERL using alveolar breath as the biological medium. Presented at: Environmental Sampling and Analysis Seminar, Okinawa, Japan, July 8-22, 2001.

Contact: Joachim D. Pleil

Abstract: Historically, ambient air (and perhaps water, soil, food, etc.) measurements were used to estimate the potential for human exposure to environmental pollutants based on various default assumptions. For instance, if a certain level of benzene was measured in the air, then a typical breathing rate times a typical pulmonary uptake percentage would yield an available blood dose approximation. This would, of course, neglect the potential for additional dermal or ingestion exposure from contaminated water unless these measurements were also made. Philosophically then, a direct measurement of this hypothetical benzene in the exhaled breath (rather than in the ambient air) would not only include the possibility of all exposure routes (inhalation, dermal, ingestion), but would also unambiguously demonstrate that such an exposure had actually occurred. After all, benzene could not come out in the breath if it had not originally entered the body somehow. Additionally, the absolute amount of the benzene in the breath can be directly coupled to the amount in the circulating blood much like blowing into the classic police "breathalyzer" instrument for alcohol infers the blood alcohol level. Finally, a series of time dependent measurements during exposure, and later after the exposure is over, can tell the researcher about the chemical's human pharmacokinetics (that is, where in the body and how long a time did the chemical reside). Researchers at the EPA's National Exposure Research Laboratory have developed and refined alveolar breath collection and analysis techniques over the past six years and have applied them to a variety of environmental investigations. This lecture presents the evolution and application of breath measurement as practiced in the Methods Development group and gives a detailed description of the sampling and analytical strategies. The focus is primarily on the use of rigid stainless steel canisters used for sampling and the methods for subsequent laboratory analysis by gas chromatography - mass spectrometry. The concepts of time dependent measurement and interpretation of the data are explained in the context of extracting valuable biological data such as residence time, target organ dose, and overall dose estimation. Various studies are presented and the results are discussed to demonstrate the utility of breath measurement for practical exposure assessment. Specifically, measurements of environmental exposure to carcinogens or suspected carcinogens such as vinyl chloride, chloroform, bromodichloromethane, benzene, trichloroethylene, and MTBE are presented. Also, the method for assessing exposure to JP-8 jet fuel, a complex mixture of thousands of hydrocarbons, is shown. Further potential applications of breath techniques in future studies are presented and concepts concerning the use of endogenous biomarkers (compounds produced by the body in response to an exposure) are introduced. This work has been reviewed in accordance with the U.S. Environmental Protection Agency's peer and administrative review process and approved for presentation and publication. Mention of tradenames or commercial products does not constitute endorsement or recommendation for use.

Lewis, R.G., Falconer, R.L., Fortune, C.R., Blanchard, F.T., and Ellenson, W.D. Passive/diffusive samplers for pesticides in residential indoor air. Presented at: International Conference on Measuring Air Pollutants by Diffuse Sampling, Montpellier, France, September 26-28, 2001.

9/26/2001

Contact: Robert G. Lewis

Abstract: Pesticides applied indoors vaporize from treated surfaces (e.g., carpets and baseboards) resulting in elevated air concentrations that may persist for long periods after applications. Estimating long-term respiratory exposures to pesticide vapors in residential indoor environments using active (pump-based) sampling systems has been costly and burdensome on occupants. Diffusion-controlled passive sampling devices (PSDs), which do not require a noisy pump and can be situated unobtrusively within the home, would offer distinct advantages. The U.S. EPA is investigating the applicability of diffusive PSDs, semipermeable membrane devices (SPMDs), solid-phase microextraction (SPME), and other gas-sorbent partitioning samplers for estimating semivolatile organic compound (SVOC) pesticides in homes. This paper presents the results of the initial evaluations of two diffusion-controlled PSDs for determination of three pesticides in room air. This work has been funded wholly by the United States Environmental Protection Agency under contract 68-D-00-206 to ManTech, Inc. It has been subjected to Agency review and approved for publication. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

Jan 1, 2001 - Dec 31, 2001

Presented Published

8/7/2001

Pleil, J.D., and Colon, M. Breath measurement of total body burden of JP-8 jet fuel for epidemiological study. Presented at: 2nd International Conference on Jet Fuel Exposure, San Antonio, TX, August 7-12, 2001.

Contact: Joachim D. Pleil

Abstract: A complex epidemiological investigation of the effects of acute exposure to JP-8 jet fuel in the U.S. Air Force was performed through the study of about 350 human subjects across six Air Force bases. The focus was on fuels system maintenance personnel as the "exposed" cohort, with members of other (non-fuels related) career fields used as a "non-exposed" control population. Exhaled breath samples were collected from subjects both pre- and post-exposure to their normal job activities, with the emphasis on the exposed cohort due to logistical limitations. Samples were collected on site in 1 liter canisters and subsequently analyzed via gas chromatography - mass spectrometry in the EPA laboratory. Breath concentration data were compiled for C4 to C12 n-alkanes and a series of nine single-ring aromatic compounds including benzene. A JP-8 "fingerprint" variable was constructed from the speciated data by summing the nonane, decane, undecane and dodecane concentrations in the breath to allow simple intersubject comparison of relative exposure. It was estimated that this fingerprint variable represents about 10 - 15% of the total JP-8 exposure. We found a large range of total exposure estimates within the nominally exposed cohorts from each base, and significant base to base variability of mean exposures. This indicates that an independent variable proportional to total exposure is necessary to rank relative exposures among subjects to avoid misclassification error when performing statistical comparisons with potential health or neurological effects. The breath data presented here appear to provide an excellent candidate for such a variable because it is based upon the JP-8 fingerprint composite of four compounds that represents a stable measure of the total fuel profile. This is an abstract of a proposed presentation; it has been reviewed in accordance with the U.S. Environmental Protection Agency's review process and approved for publication. Mention of tradenames or commercial products does not constitute endorsement or recommendation for use.

Lindstrom, A.B., and Pleil, J.D. Alveolar breath sampling and analysis in human exposure assessment studies. Presented at: Department of Anaesthesia and Intensive Care Medicine, University Hospital of Rostock, Rostock, Germany, September 25, 2001.

9/25/2001

Contact: Andrew B. Lindstrom

Abstract:

Medina-Vera, M., Harper, S.L., Wright, L.H., Coppedge, E.A., Lumpkin, M.S., and Ferrell, G. Development of chemical methods to characterize exposure to EDCs in the Neuse River Basin. Presented at: Effective Risk Management of Endocrine Disrupting Chemicals, Cincinnati, OH, September 18-19, 2001.

9/18/2001

Contact: Myriam Medina-vera

Abstract: To develop a quantitative health and environmental risk assessment of endocrine disrupting compounds (EDCs), information on exposures is essential. A full exposure assessment has complex requirements that require preliminary information to direct further research in this area. Such research begins with refining the biological and chemical methods for selected endocrine disrupting compounds in fresh and brackish, polluted and unpolluted waters, sediment, soil and selected aquatic organisms. Accurate characterization of the exposures can be done by using valid methods that are sensitive and reliable. Adequate methods provide tools that will help with the understanding of pathways of exposure, fate and transport of selected endocrine disruptors. Identification of data gaps stressed the need for better methods in the identification and quantitation of EDCs such as alkylphenols and selected toxic metals. Current efforts focus on the development of normal phase and reverse phase chromatography (HPLC), accelerated solvent extraction, solid phase extraction, and atomic spectroscopy techniques. This document has been reviewed in accordance with U.S. Environmental Protection Agency policy and approved for publication. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

Jan 1, 2001 - Dec 31, 2001

Presented Published

11/4/2001

Williams, R.W., Ryan, B., Hern, S.C., Kildosher, L., Witherspoon, C.L., and Hammerstrom, K. Personal exposures to polycyclic aromatic hydrocarbons associated with the NHEXAS pilot. Presented at: 11th Annual Meeting of the International Society of Exposure Analysis, Charleston, SC, November 4-8, 2001.

Contact: Ronald W. Williams

Abstract: Personal exposure monitoring for select polycyclic aromatic hydrocarbons (PAHs) was performed as part of the National Human Exposure Assessment Survey (NHEXAS) Pilot Study in Baltimore, MD. Twenty-four hour PM₁₀ sample collections (~5.7 m³) were performed using personal environmental monitors (PEMs-MSP Inc.) and Teflon filter media. Monitoring was performed for 47 households and 6 sampling cycles (seasons) during 1995-1996. The volunteers wore the sampling apparatus continuously except during periods of sleep, bathing or clothing changes. Participants were selected from rural, urban and suburban areas. Over 250 personal air samples were returned to the laboratory for analysis. Filter samples were extracted with dichloromethane and prepared for time-programmable fluorescence-high performance liquid chromatography and PAH quantification. A total of 9 PAHs were speciated (e.g., chrysene, benzo(a)pyrene) as well as two aggregate groupings (total PAHs, total carcinogenic PAH). Individual PAH limits of detection ranged from 0.1 to 0.01 ng/m³. Quality control from spiked filter samples indicated excellent recovery of the PAHs, typically exceeding 80% with minimal resulting artifacts (<1.0 pg/?l extract). Results indicate that ~50 % of the selected samples had detectable concentrations for 3-5 of the individual PAHs. Noted differences were observed between exposure concentrations from individuals living in rural areas as compared to urban/suburban environments. Benz(a)anthracene, benz(b)fluoranthene, benz(a)pyrene, and indeno(1,2,3-cd)pyrene were the dominant targeted PAHs in the non-rural settings. Personal exposures from the more populated environments were often one order of magnitude higher in total PAH concentrations (sometimes exceeding 10 ng/m³). Carcinogenic PAHs routinely contributed over 75% to the total PAH mass concentration. This work has been funded wholly by the United States Environmental Protection Agency under cooperative agreement # CR-822038 to Harvard School of Public Health, and contract 68-D5-0049 to ManTech Environmental Technology. It has been subjected to Agency review and approved for publication.

Williams, R.W., Rea, A.W., Suggs, J.C., Leovic, K.W., Vette, A.F., Sheldon, L.S., Rhodes, C.E., Thornburg, J., Ejire, A., and Sanders, W., Jr. Mass concentration relationships from the NERL RTP particulate matter panel study. Presented at: 11th Annual Meeting of the International Society of Exposure Analysis, Charleston, SC, November 4-8, 2001.

11/4/2001

Contact: Ronald W. Williams

Abstract: The National Exposure Research Laboratory's (NERL) Research Triangle Park (RTP) Particulate Matter (PM) Panel Study has completed a one-year investigation of personal, residential and ambient PM-related mass concentrations in two potentially susceptible subpopulations. PM_{2.5}, PM₁₀ and PM_{coarse} measurements were routinely conducted as part of the study. Personal exposures were characterized for only the PM_{2.5} size fraction. A total of 35 individuals participated. The first cohort consisted of 8 members with implanted cardiac defibrillators. The second cohort consisted of 27 African-Americans with controlled hypertension and living in a low/moderate socio-economic-status neighborhood. All of the participants were at least 50 years of age, non-smokers, and lived independently in their own residence in the RTP, NC area. The exposure assessment for both groups was conducted in identical manner. Each participant and their residence (indoor/outdoor) was monitored for 7 consecutive days during each of four seasonal periods (summer 2000, fall 2000, winter 2001, spring 2001). Daily diaries were used to determine the participant's activity patterns. Preliminary results from the first two seasons indicated that daily personal PM_{2.5} mass concentrations were typically higher than matched residential or ambient measurements (e.g., fall African-American cohort mean personal = 23.9, indoor = 21.5, outdoor = 19.1, ambient = 20.2 ?g/m³). The maximum PM_{2.5} personal exposure concentration observed during the first half of the study for either cohort was 99 ?g/m³. PM_{2.5} mass concentrations were determined to represent approximately 60-90% of the total outdoor PM₁₀ mass. Associations between personal PM_{2.5} exposures and ambient mass concentrations varied between seasons and increased significantly for both cohorts (e.g., summer cardiac defibrillator cohort r² = 0.08, fall r² = 0.52). Higher residential air exchange values during the fall appear to be responsible for this finding. Residential outdoor PM_{2.5} mass concentrations from all homes highly correlated with those from the ambient site even over distances of up to 70 km (r > 0.85). PM_{2.5} personal cloud estimates for the first two seasons for both cohorts averaged ~ 9 ?g/m³. PM mass concentration data and exposure relationships from all four seasons will be discussed at the time of presentation. This work has been funded wholly by the United States Environmental Protection Agency under contract #68-D-99-012 to the Research Triangle Institute and assistance agreement #CR-828186-01-0 to Shaw University. It has been subjected to Agency review and approved for publication.

Jan 1, 2001 - Dec 31, 2001

Presented Published

12/17/2001

Stout, II, D.M., Mason, M.A., and Vallero, D.A. The spatial and temporal distribution of chlorpyrifos in the U.S. EPA indoor air quality (IAQ) test house following crack and crevice type applications. Presented at: International Conference of Pesticide Exposure and Health Society for Occupational and Environmental Health, Bethesda, MA, December 17-21, 2001.

Contact: Daniel M. Stout

Abstract: Pesticides found in homes may result from indoor applications to control household pests or by translocation from outdoor sources. Pesticides disperse according to their physical properties and other factors such as human activity, air exchange, temperature and humidity. Insecticide treatments to the cracks and crevices within residential dwellings is the most common technique used to control insect pests. A study was conducted in the U.S. EPA IAQ test house to explore the spatial and temporal distribution of chlorpyrifos following a crack and crevice application. A 0.5% chlorpyrifos formulation was applied to the kitchen by a licensed pest control operator. Following the application, measurements were made in the kitchen, den and master bedroom over a 21-day period. Airborne concentrations were collected using both polyurethane foam (PUF) and a XAD/PUF media. Transferable residues were determined using a press sampler and EMPORE TM (C18) extraction discs. Spatial distributions, application surface loadings, and redeposition were measured using 10 cm² deposition coupons. Square sections were cut from existing carpet to determine the total extractable residues. Surface wipes were collected from formica surfaces in the kitchen. Vacuum dislodgeable residues were collected from the den. Results will provide quantitative data to clarify the physical and chemical behavior of chlorpyrifos following indoor crack and crevice applications and the potential for human exposures. This work has been funded wholly or in part by the United States Environmental Protection Agency. It has been subjected to Agency review and approved for publication. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

Rea, A.W., Williams, R.W., Rodes, B., Hermann, M., and Thornburg, J. Real-time personal nephelometer and time activity data from the NERL RTP PM panel study. Presented at: 11th Annual Meeting of the International Society of Exposure Analysis, Charleston, SC, November 4-8, 2001.

11/4/2001

Contact: Ronald W. Williams

Abstract: A longitudinal particulate matter (PM) exposure study was conducted in the Research Triangle Park, NC, area between June 2000 and June 2001. Participants were selected from two groups of potentially susceptible sub-populations: a group of African-Americans living in an environmental justice area in southeast Raleigh, and a group of cardiac patients with implanted cardiac defibrillators in Chapel Hill, NC. All of the participants were over 50 years old, ambulatory, and non-smokers. Approximately 35 participants were sampled for 7 consecutive days during each of 4 sampling seasons (~28 days total for each participant). Personal and indoor monitoring included continuous (1 min. avg. time) nephelometer measurements (personal DataRAM, MIE Inc.). Detailed time activity information (15 min time resolution), follow up questionnaire data on exposure to particle sources, and residential information were also collected. The nephelometer data were displayed daily in the field for participants to view. Details on the activities corresponding to PM exposure peaks measured by the nephelometers were recorded in the field. Analysis of time activity patterns indicates that participants from both cohorts spent similar amounts of time in the six microenvironments examined during both the summer and fall seasons. (Winter and spring data are unavailable at this time, but will be presented.) Participants from both cohorts spent >70% of their time inside at home, ~10% of their time both inside away from home and at work, and ~5% of their time outside at home or outside away from home and in transit. PM exposure for each cohort was similar in most cases. During the summertime, the nephelometer mass for being outside at home was ~10 times higher for the African American cohort than during the fall season. The time activity data show that this is due to frequent mowing, grilling, and other particle generating outdoor activities. Nephelometer mass recorded while participants were inside away from home was ~10 times higher in the summertime for the Cardiac cohort than in the fall. This was due to elevated PM exposure while in restaurants either due to cooking or nearby smokers. Other activities that contributed to personal PM exposure included spraying aerosols (air fresheners, cleaners, or hair spray), cleaning cat litter boxes, burning wood in a fireplace, burning trash outside, outdoor grilling, and automobile/diesel exhaust. This work has been funded wholly or in part by the US EPA under Contract No. 68-D99-012 to the Research Triangle Institute. It has been subjected to Agency review and approved for publication. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

Jan 1, 2001 - Dec 31, 2001

Presented Published

Thomas, K.W., Sandler, D.P., Blair, A., and Alavanja, M.C.R. Agricultural health study/pesticide exposure study. Presented at: AHS National Advisory Panel Meeting, Chapel Hill, NC, March 8-9, 2001.

3/8/2001

Contact: Ellen W. Streib

Abstract: The Agricultural Health Study (AHS) is a prospective epidemiologic study of a large cohort of pesticide applicators and their spouses in Iowa and North Carolina. The Pesticide Exposure Study is a sub-study to evaluate exposure factors and to provide data to assess exposure classification procedures. Exposure to two applied pesticides (2,4-D and chlorpyrifos) will be measured for up to 160 applicators and their families. Applicators are selected based on application methods and uses of personal protective equipment of interest for the epidemiological study cohort. Two exposure measurement approaches are being employed: a) a combination of dermal patch, hand wipe, and personal air measurements collected during an observed handling, mixing, loading, and application (HMLA) and, b) urinary biomarker measurements from samples collected in the morning before and at two time intervals after the observed HMLA. A target goal of monitoring for 28 applicators was set for Year 1 work in Iowa; however, only 10 applicators were monitored due to scheduling delays and an early planting season. Participation information and pesticide use data are provided for Year 1 monitoring participants. Preliminary measurement results will be shown for Year 1 monitoring, including examples of dermal sample concentrations and urine concentrations for applicators and family members. The study will continue in Year 2 in Iowa and North Carolina, with a goal of monitoring 70 applicators and repeat monitoring for 10 applicators. Current participation information is provided for Year 2 screening and recruitment to date. This work has been funded in part by the U.S. Environmental Protection Agency. It has been subjected to Agency review and approved for publication. Mention of trade names of commercial products does not constitute endorsement or recommendation for use.

Cohen-Hubal, E.A., and Sheldon, L.S. The US EPA's dermal exposure research program in support of the food quality protection act. Presented at: X2001 Exposure Assessment in Epidemiology and Practice Conference, Goteborg, Sweden, June 10-13, 2001.

6/10/2001

Contact: Elaine A. Cohen-hubal

Abstract: The Food Quality Protection Act of 1996 (FQPA) requires that children's risks to pesticide exposures be considered during the tolerance-setting process. FQPA requires exposure assessments to be conducted for all pesticides sources, not just food sources. It also requires that assessments use high quality and high quantity exposure data or models based on exposure factors generated from existing, reliable data. Currently, data on children's exposures and activities are very limited and insufficient to support quantitative assessments that do not rely heavily on major default assumptions as substitutes for missing information (1,2). Results derived from an initial assessment of critical exposure pathways and factors for assessing children's residential exposures to pesticides (1) indicate that dermal exposure and nondietary ingestion may result in high residential exposures for children. However, there are so few data associated with these pathways that exposure estimates may vary by orders of magnitude, depending upon the assumptions and exposure factors selected. Studies across all ages of children, but especially for very young children, are required to characterize activities that contribute to dermal exposure in important microenvironments. Studies are also needed to characterize contact and transfer factors for non-dietary ingestion. The goal of the U.S. EPA National Exposure Research Laboratory program in support of FQPA is to develop and evaluate protocols for assessing children's aggregate exposure to pesticides, and to conduct fields studies to collect data required to reduce the reliance on default assumptions in development of quantitative exposure assessments. The specific aim of the work described in this presentation is to evaluate the approaches available for assessing dermal exposure resulting from contact with residue contaminated residential surfaces.

Jan 1, 2001 - Dec 31, 2001

Presented Published

Lyu, C., Chuang, J.C., Wilson, N.K., and Morgan, M.K. Recruitment strategies for an exposure measurement study of preschool children. Presented at: American Public Health Association, Atlanta, GA, October 21-26, 2001.

10/21/2001

Contact: Marsha E. Morgan

Abstract: Recruiting study participants is always a challenge for researchers. It poses an even bigger challenge for researchers to recruit participants for a study involving intrusive, burdensome data collection activities. A study of preschool children's exposure to persistent organic pesticides and other persistent organic pollutants is being conducted in North Carolina and Ohio. Participants are recruited from daycare centers and from the general population using a random digit dialing (RDD) method. Participant data are collected over a 48-hour period. The data include samples of food, beverages, drinking water, urine, indoor and outdoor air, hand wipes, indoor floor dust, play area soil, dislodgeable pesticide residues, smooth floor wipes, and food preparation surface wipes. Personal interviews are conducted with the adult caregiver and the daycare staff to collect additional exposure information. Children's activities during the 48-hour period are recorded by the adult caregiver and daycare staff in activity diaries. Strategies for enhancing the response rates are based on previous pilot studies. These strategies include: a tailored recruitment plan for the target population (i.e., daycare centers, working parents, non-working parents), letters of endorsement from childcare associations and state licensing agencies, a certificate of confidentiality, crafting a persuasive introductory letter and study brochure, using FedEx for delivering introductory letters, multiple follow-ups (telephone and personal visit), participant training, non-monetary incentives, and monetary incentives. The initial recruitment results are 73% daycare center response rate, 80% daycare parents response rate, and 68% RDD response rate. This work has been funded wholly or in part by the United States Environmental Protection Agency. It has been subjected to Agency review and approved for publication.

Rea, A.W., Williams, R.W., Sheldon, L.S., Thornburg, J., and Rhodes, C. Personal particulate matter exposure monitoring: identifying important sources, activities, and locations based on data from the NERL RTP PM panel study. Presented at: American Association for Aerosol Research, Portland, OR, October 15-19, 2001.

10/15/2001

Contact: Ronald W. Williams

Abstract: A longitudinal particulate matter (PM) exposure study was conducted in the Research Triangle Park, NC area between June 2000 and June 2001. Participants were selected from two groups of potentially susceptible sub-populations: a group of African-Americans living in an environmental justice area in southeast Raleigh, and a group of cardiac patients with implanted cardiac defibrillators in Chapel Hill, NC. All of the participants were over 50 years old, ambulatory, and non-smokers. Approximately 35 participants were sampled for 7 consecutive days during each of 4 sampling seasons (~28 days total for each participant). Personal and indoor monitoring included PM_{2.5} mass as well as continuous (1 min. avg. time) nephelometer measurements (personal DataRAM, MIE Inc.). Detailed time activity information (15 min time resolution), follow up questionnaire data on exposure to particle sources, and residential information were also collected. Participants from both cohorts spent the majority (>70%) of their time inside at home during the summer and fall seasons (winter and spring data are unavailable at this time, but will be presented). Both groups also spent about the same amount of time outside away from home (1-4%), in transit (4-6%), and inside away from home (9-10%). The cardiac participants spent ~5% of their time outdoors at home during both the summer and fall seasons, whereas the African-American participants spent 2.5% of the time outside at home. Despite the similarities in time activity patterns between each season, PM exposures measured by the personal nephelometers varied similarly for both cohorts. Most notably, PM exposure outside at home was about six times higher in the summer than in the fall. Personal PM exposure while being inside away from home was about five times higher in the summer than in the fall. These differences were likely due to different activities noted during each season. For example, participants noted more outdoor grilling, mowing, and burning trash in the summer season. Mean (? std. dev.) PM exposure while at home (49 ? 923 microg/m³ summer; 35 ? 117 micrograms per cubic meter fall), at work (41 ? 61 micrograms per cubic meter summer; 50 ? 71 micrograms per cubic meter fall), traveling (39 ? 80 micrograms per cubic meter summer; 30 ? 48 micrograms per cubic meter fall), and outside away from home (39 ? 37 micrograms per cubic meter summer; 32 ? 42 micrograms per cubic meter fall) were similar during both summer and fall seasons. The variability associated with being at home was due to more frequent frying and other types of cooking in the summertime. Other personal activities that contributed to personal PM exposure included spraying aerosols (air fresheners, cleaners, or hair spray), cleaning cat litter boxes, burning wood in a fireplace, burning trash outside, outdoor grilling, and automobile/diesel exhaust. This work has been funded wholly or in part by the US EPA under Contract No. 68-D99-012 to the Research Triangle Institute. It has been subjected to Agency review and approved for publication. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

Jan 1, 2001 - Dec 31, 2001

Presented Published

Vette, A.F., Williams, R.W., Riediker, M., and Thornburg, J. Indoor/outdoor particle size distributions measured in select homes in the Raleigh-Durham-Chapel Hill, NC area. Presented at: American Association for Aerosol Research, Portland, OR, October 15-19, 2001.

10/15/2001

Contact: Ronald W. Williams

Abstract: Particle size distributions were measured indoors and outdoors of six residences in the Raleigh-Durham-Chapel Hill, NC area to characterize the factors affecting particle concentrations in the indoor environment, including infiltration of outdoor aerosols. Size resolved particle number concentrations were measured using a Scanning Mobility Particle Spectrometer (SMPS; TSI Model 3936) and an Aerodynamic Particle Sizer (APS; TSI Model 3320). Indoor and outdoor aerosol concentrations were alternately measured through a ball-valve switching manifold. Concurrent measurements of indoor air exchange rates were made continuously by releasing sulfur hexafluoride and monitoring concentration decay using a portable gas chromatograph (Lagus Applied Technologies). In southeast Raleigh, data was collected over multiple seasons as part of the National Exposure Research Laboratory's Research Triangle Park Particulate Matter Panel Study during fall 2000 (1 home), winter and spring 2001 (4 homes). One home was monitored in Chapel Hill during summer 2000 and one in Durham during spring 2001. The housing stock varied considerably in size (one and two story; 1000-2500 square feet), construction (brick and wood siding) and age (12-46 years).

Results from all of the houses show that particles between 0.1 and 1 micrometer had the highest indoor/outdoor particle concentration ratios during non-source periods. However, average indoor/outdoor ratios in this size region varied considerably from about 0.5 to 0.9, both between homes and within the same home during different seasons. Hourly air exchange rates also varied between homes and seasons, and generally ranged from about 0.2/h to 3/h. Air exchange rates in the older homes varied by a factor of 3 to 4 between seasons, even when doors and windows were closed. The temperature differential between indoors and outdoors was very influential in affecting air exchange rates in older homes. Consequently, indoor/outdoor particle concentration ratios in older homes were higher and more seasonally variable than in newer homes. This work has been funded wholly or in part by the United States Environmental Protection Agency under Contract No. 68-D99-012 to the Research Triangle Institute. It has been subjected to Agency review and approved for publication. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

Morgan, M.K., Vallero, D.A., Chuang, J.C., Lyu, C., and Wilson, N.K. Emerging approaches for assessing the exposure of children to endocrine disruptors. Presented at: National Ground Water Association 2nd International Conference on Pharmaceuticals and Endocrine Disrupting Chemicals in Water, Minneapolis, MI, October 9-11, 2001.

10/9/2001

Contact: Marsha E. Morgan

Abstract: Humans can be exposed to endocrine disrupting chemicals (EDC's) from environmental sources such as water, food, air, dust and soil. A major concern is that children may be exposed to higher amounts of pollutants than adults because of their different activity patterns, higher body-surface to volume ratios, and greater water and food consumption per kilogram body weight. A pilot study, titled the Children's Total Exposure to Persistent Pesticides and Other Persistent Organic Pollutants (CTEPP), examines the possible exposures of 256 preschool children between the ages of 18 months and 5 years to pollutants commonly found in their everyday environments. This three-year pilot study will quantify the aggregate exposures for these preschool children. Monitoring will be performed at their daycare centers and homes in twelve counties in North Carolina and Ohio during a 48-hour sampling period. Participants will be recruited from daycare centers and from the general population using a random digit dialing (RDD) method. Samples will be chemically analyzed for over 40 persistent pesticides and organic pollutants that children may contact in their daily surroundings. Samples collected over a 48-hour period include food, beverages, drinking water, urine, indoor and outdoor air, hand wipes, indoor floor dust, play area soil, dislodgeable pesticide residues, smooth floor wipes, and food preparation surface wipes. Samples will be chemically extracted and analyzed by GC/MS. These data will help to quantify the dermal, ingestion, and inhalation exposure pathways of these children to suspected EDC's such as herbicides (atrazine), insecticides (organophosphorus, carbamate, pyrethrin and organochlorine), phthalate esters (butylbenzyl, di-n-butyl), phenols, polychlorinated biphenyls, and polycyclic aromatic hydrocarbons. Total exposure concentrations will be determined for the preschool children through environmental sampling, time-activity diaries, food diaries, questionnaires and by the videotaping of up to 10% of the children in homes in Ohio. Potential doses will be estimated by analysis of the urine samples. Preliminary results will be discussed for water samples analyzed for atrazine from daycare centers and homes. This work has been funded wholly or in part by the United States Environmental Protection Agency under contract #68-D-99-011 to Battelle. It has been subjected to Agency review and approved for publication.

Jan 1, 2001 - Dec 31, 2001

Presented Published

Wilson, N.K., Chuang, J.C., Lyu, C., and Morgan, M.K. PAH concentrations in multiple media at the homes and child day care centers of 130 North Carolina children. Presented at: 18th International Symposium on Polycyclic Aromatic Compounds, Cincinnati, OH, September 9-13, 2001.

9/9/2001

Contact: Marsha E. Morgan

Abstract: In the late summer of 2000 and the early spring of 2001, in the USEPA-sponsored program, "Children's Total Exposures to Persistent Pesticides and Other Persistent Organic Pollutants" (CTEPP), we conducted a field pilot study of the potential exposures of 130 North Carolina preschool children and their primary caregivers to persistent pollutants in their everyday environments, both at home and at their day care centers. Over a 48-hr period for each participant, we collected samples of indoor and outdoor air, house and classroom dust, play area soil, children's hand surface wipes, urine, and diet. The samples were analyzed for 20 polycyclic aromatic hydrocarbons (PAH) as well as for other target analytes. At the end of March 2001, we completed the field sample collection in the six selected North Carolina counties. We report here the preliminary results of the analyses of these multiple environmental media for PAH. This work has been funded wholly or in part by the United States Environmental Protection Agency under contract #68-D-99-011 to Battelle. It has been subjected to Agency review and approved for publication.

Thomas, K.W., Sheldon, L.S., Gordon, S.M., Reynolds, S., Lynch, C., and Alavanja, M.C.R. Agricultural health study/pesticide exposure study: year 1 measurement results. Presented at: 11th Annual Meeting of the International Society of Exposure Analysis, Charleston, SC, November 4-8, 2001.

11/4/2001

Contact: Ellen W. Streib

Abstract: The Agricultural Health Study (AHS) is a prospective epidemiologic study of pesticide applicators and their spouses in Iowa and North Carolina. Exposure to targeted applied pesticides (2,4-D or chlorpyrifos) is being measured for a subset of applicators and their families in the AHS Pesticide Exposure Study to assess exposure classification procedures. Applicators are selected based on application methods and uses of personal protective equipment. Potential exposures are measured on one day of pesticide mixing, loading, and application (MLA) using dermal patch, hand wipe, and personal air samples. Urinary biomarker levels are measured in pre- and post-application samples from each applicator and for participating spouses and children. Samples extracted are analyzed by GC/MS or LC/MS. Questionnaires and observations of pesticide MLA activities provide information about work practices, use of protective equipment, and hygiene. Monitoring was completed for ten Iowa private pesticide applicators during the first year of the study (spring/summer of 2000). Dermal samples were collected by placing ten cellulose or gauze patches on the body. The surface area of each patch was sized proportionately to the body area it represented. Patches were combined for extraction. Dermal patch measurement results ranged from 7 to 1100 g/sample for eight 2,4-D applicators that used spray application methods, and 2 g/sample for both chlorpyrifos applicators that applied a granular product. Hand wipe samples were collected using a sub-sampling technique that wipes approximately 10% of the hand surface area. Hand wipe measurement results ranged from 3 to 1400 g/sample for the 2,4-D applicators while samples from the chlorpyrifos applicators contained less than the quantifiable limit of 1 g/sample. Post-application levels of 2,4-D in urine ranged from 4 to 110 g/g creatinine for 2,4-D applicators. Use of the target chemical on days before and after the monitoring day affected pre- and post-application urinary levels of 2,4-D for some applicators. Spouse and child urinary biomarker levels of 2,4-D ranged from 1.5 to 10 g/g creatinine. Urinary levels of the 3,5,6-trichloropyridinol (TCP) metabolite of chlorpyrifos were 4 g/g creatinine for the two chlorpyrifos applicators and the spouse of one of those applicators. Relationships between measured amounts, work practices, and the amount of applied active ingredient will be presented for the ten pesticide applicators monitored to date. This work has been funded in part by the U.S. Environmental Protection Agency. It has been subjected to Agency review and approved for publication. Mention of trade names of commercial products does not constitute endorsement or recommendation for use.

Jan 1, 2001 - Dec 31, 2001

Presented Published

Clothier, J.M., Camann, D.E., Thomas, K.W., and Gordon, S.M. Hand wipe subsampling method for use with biomarker measurements in the agricultural health study/pesticide exposure study. Presented at: 11th Annual Meeting of the International Society of Exposure Analysis, Charleston, SC, November 4-8, 2001.

11/4/2001

Contact: Ellen W. Streib

Abstract: Dermal exposure studies incorporating urinary biomarker measurements are complicated because dermal sampling may intercept or remove the target chemical before it is absorbed. A hand wipe subsampling method has been developed using polyurethane foam-tipped (PUF) swabs to minimize the potential interference with urinary biomarker measurements. This paper describes tests to assess the method against an established method that measures whole hand residues by wiping with alcohol wetted gauze. Three neutral pesticides (chlorpyrifos, 2,4-D ethylhexyl ester and 2,4-D butoxyethyl ester) and one acidic herbicide (2,4-D) were tested in the laboratory, followed by field testing on seven pest control operators using both wipe procedures. Twelve 1 x 3 cm² rectangular areas were defined on the back and palm side of each hand using a commercially prepared rubber stamp inked with a red, water soluble 'tattoo' ink. Hands were allowed to dry approximately 15 minutes prior to permitting exposure-related activities. Hand surface areas were estimated using hand traces and digital imaging. When pesticide activities were completed, residues were wiped from within the inked areas on both hands using pre-cleaned isopropanol-wetted PUF swabs. The time required to apply twelve 1 cm x 3 cm ink outlines to each of two hands and then to collect the residues from within the outlined areas averaged 5 minutes. Wooden handles were clipped from swabs immediately after the wipe procedure and swab tips stored without solvent for analysis. The pesticides were removed from the swab tips by solvent extraction with acidified dichloromethane, reconstituted, and analyzed on a GC/MS using selective ion monitoring. PUF swab wipe efficiency was found to be equal to that of the whole hand wipe which has been shown to remove 80-100% of residues. Values generated using the digital hand trace indicated that 6-9% of the total hand surface was wiped with the swab. The extraction method achieved 75-125% recovery of the four pesticides in a single extraction. Estimates of residue loading from the subsampling method in field tests were higher than estimates from the whole hand method, but the correlation between the methods was 0.97. Based on measurements taken from two residential applications of chlorpyrifos using a hand-held sprayer, residues deposited on the palm area were higher than residues deposited on the back of the hand but lower than residues deposited on the thumb and forefinger. The hand wipe subsampling method is currently being used on pesticide applicators in the Agricultural Health Study/Pesticide Exposure Study. This work was funded by the U.S. Environmental Protection Agency. It has been subjected to Agency review and approved for publication. Mention of trade names of commercial products does not constitute endorsement or recommendation for use.

Falconer, R.L., and Morgan, M.K. Occurrence of chiral pesticides in human breast milk and other media. Presented at: Society of Environmental Toxicology and Chemistry 22nd Annual Meeting, Baltimore, MD, November 11-15, 2001.

11/11/2001

Contact: Marsha E. Morgan

Abstract: Enantiomers of chiral pesticides have the same physical and chemical properties; therefore transport processes, such as leaching and volatilization, and abiotic reactions, such as hydrolysis and photolysis, do not discriminate between the enantiomers. Since enzymes themselves are chiral molecules, however, they can react selectively with one of the enantiomeric forms. Thus, metabolism by microorganisms in water and soil and in higher organisms often leads to non-racemic residues. Examining the enantiomeric patterns of pesticides can thus provide a sensitive indicator of biological degradation. Numerous studies have been done looking at chiral pesticides and their metabolites in the environment and several researchers have reported preferential degradation/accumulation of pesticide enantiomers in biota. Unfortunately, very little work has been done to date on chiral pesticides in the human body and indoor environment even though past research has shown that enantiomers of biologically active chiral molecules can differ in potency, pharmacological action, metabolism, toxicity and kinetics. This study looks at the enantiomeric patterns of chiral pesticides and their chiral metabolites in human breast milk and adipose tissue as well as in indoor media including house dust. Several human breast milk samples showed selective degradation for o,p'-DDT, trans-chlordane, cis-chlordane, oxychlordane and -hexachlorocyclohexane, although pesticide levels were near or at detection limits for most compounds. This work has been funded wholly or in part by the United States Environmental Protection Agency and has been subjected to Agency review and approved for publication.

Jan 1, 2001 - Dec 31, 2001

Wilson, N.K., Lyu, C., Chuang, J.C., and Morgan, M.K. CTEPP: recruiting and field sampling in North Carolina and Ohio. Presented at: 11th Annual Meeting of the International Society of Exposure Analysis, Charleston, SC, November 4-8, 2001.

Presented Published

11/4/2001

Contact: Marsha E. Morgan

Abstract: The research field study (CTEPP) of approximately 260 preschool children's exposures to persistent organic pollutants in their everyday environments began in early 2000. CTEPP is a multimedia study of the children's aggregate (total) exposures over a 48-hr period, both at their homes and day care centers. The aggregate exposures of each child's primary caregiver, usually a parent, are also estimated. Participants are randomly selected from six counties in North Carolina and six in Ohio. Half of the children attend day care and half do not. Children in the targeted age group who attend day care are randomly selected from participating day care centers. Participants, who did not attend day care centers, were selected using random digit dialing. Samples include indoor and outdoor air, house and classroom dust, play area soil, liquid and solid food, drinking water, hand wipes, and urine. In homes or classrooms where pesticides have been recently applied, floor dislodgeable residues and surface wipes of the floor and food preparation surfaces are also collected. Extensive questionnaire information on household characteristics and activity diaries for the children are also collected. Field sampling for a total of 130 North Carolina preschool children (63 and 67 from day care centers and homes, respectively) between July 2000 and March 2001 is complete. Field sampling is being performed in Ohio and will be complete in late Fall 2001. We summarize here the recruiting and sampling results, along with some preliminary results of the multimedia chemical analyses for selected North Carolina households. This work has been funded wholly or in part by the United States Environmental Protection Agency under contract #68-D-99-011 to Battelle. It has been subjected to Agency review and approved for publication.

Morgan, M.K., Chuang, J.C., Lyu, C., and Wilson, N.K. CTEPP: the database. Presented at: 11th Annual Meeting of the International Society of Exposure Analysis, Charleston, SC, November 4-8, 2001.

11/4/2001

Contact: Marsha E. Morgan

Abstract: The research study, Children's Total Exposure to Persistent Pesticides and Other Persistent Organic Pollutants, (CTEPP), examines the exposures of approximately 260 preschool children between the ages of 18 months and 5 years and their primary adult caregivers to pollutants commonly found in their everyday environments. The major objectives of this three-year pilot study are to quantify children's aggregate exposures, apportion the exposure pathways, identify the important exposure media, and formulate the important hypotheses for future testing. Participants are recruited from randomly selected day care centers and homes in six North Carolina and six Ohio counties. Monitoring is performed during 48-hr sampling periods at the children's day care centers and homes. Samples are being analyzed for over 40 persistent pesticides and other persistent organic pollutants that children may contact in their daily surroundings. Samples collected over the 48-hour period include food, beverages, drinking water, urine, indoor and outdoor air, hand wipes, indoor floor dust, play area soil, dislodgeable pesticide residues, smooth floor wipes, and food preparation surface wipes. Total exposures are determined for the preschool children through environmental sampling, time-activity diaries, food diaries and questionnaires. In addition, 10% of the preschool children are videotaped for about 2 hours at homes in Ohio to supplement the activity diaries and observations. Potential doses (aggregate exposure/kg body weight) will be estimated from the multimedia and activity data, and absorbed dose will be estimated when possible from the urine data. All of this information is being incorporated into the CTEPP database. This valuable database will be used to quantify the total exposures of these children and their primary caregivers to pollutants in their everyday environments. The data will also be used to apportion the dermal, ingestion, and inhalation exposure pathways of these preschool children and their caregivers to several classes of pollutants (pesticides, phthalate esters, phenols, polychlorinated biphenyls, and polycyclic aromatic hydrocarbons). Currently, field sampling in North Carolina is complete, and the respective portion of the database is expected to be finished in late 2001. Field activities in Ohio are on-going with an anticipated completion date by December 2001. When completed, this database will be one of the largest resources for characterizing young children's exposures to pollutants in their everyday environments. However, because of the small sample size of this research study, the results cannot be generalized beyond the sampled population. This work has been funded wholly or in part by the United States Environmental Protection Agency under contract #68-D-99-011 to Battelle. It has been subjected to Agency review and approved for publication.

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Presented Published

11/4/2001

Fortmann, R., and Sheldon, L.S. Demonstration of low cost, low burden exposure monitoring strategies for use in longitudinal cohort studies. Presented at: 11th Annual Meeting of the International Society of Exposure Analysis, Charleston, SC, November 4-8, 2001.

Contact: Ellen W. Streib

Abstract: A large longitudinal cohort study designed to evaluate the association between children's exposures to environmental agents and health outcomes presents many challenges for exposure monitoring. Exposure of the child must be measured for multiple chemicals through multiple pathways over an extended period of time from conception through puberty. In most exposure monitoring studies, substantial expense is incurred by the field staff traveling to a participant's home to collect the needed exposure data and samples. Multiple visits to a participant's residence increase the participant burden and negatively impact participant recruitment and retention. Validated strategies and data collection methods are needed to minimize the time spent in the field to collect the required exposure data/samples and reduce the burden on the participants. The primary objective of the study described in this paper is to develop and demonstrate relevant, low cost, low burden monitoring strategies that can be used in a longitudinal epidemiological study that focuses on pregnant women and young children. The study will focus on (1) strategies for recruiting and retaining participants and (2) demonstrating that participants can reliably perform simple measurement methods for assessing human exposures to environmental contaminants. In the first task of the study, focus group meetings will be conducted with pregnant women and care givers of young children to identify participant concerns and potential issues associated with recruiting and retaining participants in a long-term exposure study. The focus groups will also be used to evaluate the feasibility for remote data collection with the proposed methods. In the second task, 12-month pilot longitudinal exposure studies will be performed to evaluate measurement strategies for children in 0 to 1 year, 3 to 5 year, and 6 to 8 year old age groups. Different meta data (e.g., questionnaires, time-activity data, source information), environmental measurements (e.g., with passive badge samplers, grab samples, and real-time electronic monitors), and biological samples (e.g., breast milk, child's urine, saliva) will be collected for each age group. Innovative information technology (IT) devices will be placed in the participants' homes to collect and report questionnaire and time-activity data and to prompt participants to collect environmental and biological samples. Simple devices such as passive monitors, direct read monitors, and electronic sensors will be used to collect pollutant concentration data. The participants will complete questionnaires periodically and be responsible for collecting their environmental and biological samples following prearranged protocols and schedules. Samples will be mailed by the participant to the laboratories for analysis. Study data will be analyzed to determine if participants can reliably collect and return samples for exposure measurements and complete questionnaires on a routine schedule. The study results will be used as input to the design of exposure measurement components of the proposed longitudinal cohort study. This work was funded by the Environmental Protection Agency. It has been subjected to Agency review and approved for publication. Mention of trade names of commercial products does not constitute endorsement or recommendation for use.

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Rodes, C.E., Lawless, P.A., Thornburg, J., Zweidinger, R.B., Norris, G.A., Williams, R.W., Evans, G.F., Wallace, L.A., Sheldon, L.S., and McDow, S.R. The potential influences of face velocity on PM artifact losses for exposure samplers using teflon filter collection substrates. Presented at: 11th Annual Meeting of the International Society of Exposure Analysis, Charleston, SC, November 4-8, 2001.

Contact: Ronald W. Williams

Abstract: The influences of artifact formations and losses on Particulate Matter (PM) sampler collection surfaces are well documented, especially for nitrates (Hering and Cass, 1999), and SVOC's (McDow, 1999), and more recently for speciated carbon (Turpin and Lim, 2001). These artifact biases not only affect speciation analyses, but also importantly, the total PM mass concentration. An intercomparison of methods for PM mass concentration for the PM_{2.5} fraction in four exposure panel studies evaluating the associations between PM and selected health indicators suggests that the bias relationships between samplers appear to be partially dependent upon the relative face velocities through the Teflon filter deposits. This paper will address the hypothesis that face velocity through Teflon filters is related to "blow-off" (negative) losses for volatile species, based on two assumptions: (a) the volatile portion exists in sufficient quantities for the effect to be observed, and (b) the influence is not obscured by the simultaneous occurrence of positive artifacts (chemical or physical). Face velocity biases could prove to be important for exposure studies where associations of ambient, indoor, and personal exposure samplers with cohort health indicators are being investigated. For example, ambient PM_{2.5} samplers such as the EPA FRM sampler have face velocities (79 cm/s) that can be factors 5 to 10 greater than personal exposure samplers (MSP 2 lpm PEM, 15 cm/s). The effective filter face velocity must take into account the porosity of the support matrix, which for the FRM sampler, has only 29% of the surface perforated. Large day-to-day variations can occur in the ambient concentrations of semi-volatile species (e.g. West Coast nitrates, Winter wood smoke PM), biasing the sampling methods differently on a daily basis, and confounding associations with the health measures. Importantly, PM chemistry may vary between outdoor and indoor sampling environments, for example, given the much lower acidity levels, and often higher ammonia concentrations indoors. Between-method comparison ratios will be presented for 2 and 4 lpm MSP PEM's, Harvard Impactor indoor and outdoor samplers, Andersen FRM's, URG DFPSS and VAPS samplers, and Andersen dichotomous samplers, showing that in the majority of the cases, the sampler collecting the greatest mass had the lowest face velocity. Significant biases tended to occur in scenarios where volatile species were known to exist in sufficient quantities. Concurrent artifact phenomena/interventions explaining the exceptions were noted to include the presence of sodium carbonate denuders which limited positive nitrate formation, and excessive loadings on impactor surfaces which resulted in crustal particle bounce. This work has been funded in part by the US EPA under Contract No. 68-D5-0040 and EPA cooperative agreement CR822981-01 to the Research Triangle Institute. It has been subjected to Agency review and approved for publication. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

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Leovic, K.W., Highsmith, V.R., Sheldon, L.S., Williams, R.W., Cohen-Hubal, E.A., Morgan, M.K., Stout, II, D.M., and Ejire, A. Recruiting, retaining, and reporting exposure study results to participants and the public. Presented at: 11th Annual Meeting of the International Society of Exposure Analysis, Charleston, SC, November 4-8, 2001.

Contact: Kelly W. Leovic

Abstract: EPA's National Exposure Research Laboratory (NERL) is developing techniques and capabilities to recruit and retain participants in exposure measurement studies and to effectively report study results to participants and the public. These techniques are being applied in three NERL field studies located in the Research Triangle Park (RTP), NC area: (1) the NERL RTP Particulate Matter Panel Study: 27 African-Americans living in a low socioeconomic status area and eight cardiac patients; (2) the Study to Test the Feasibility of Using the Macro-activity Approach to Assess Dermal Exposure: nine daycare centers that apply pesticides; and (3) the Study of Pet-Borne Diazinon Residue Translocation From Treated Turf to Residential Interiors and to Human Subjects: nine families with an indoor/outdoor pet and a young child. Effective recruitment strategies include both targeting the specific population and widespread outreach to raise the study's visibility in the community. Recruitment techniques aimed at targeting a specific study population include: learning about the audience/target population and focusing on their needs, interests, and activities; sending initial introductory letters to potential participants followed by a phone call; posting flyers in areas frequented by potential participants (e.g., community centers, churches, veterinary offices); collaborating with or soliciting letters of support from community organizations and leaders; and running advertisements in targeted publications. More widespread announcements such as press releases have also been helpful in raising the visibility of a study in the community. Recruitment challenges for our studies have included: the time commitments required to participate in exposure studies; relatively low compensation for participation; and strict study eligibility criteria. Once participants are recruited for a study, it is important to retain them for the duration of the study. Techniques that we have applied to promote participant retainment include: emphasizing the importance of the participant's role in the study and the benefits to them and their community; providing monetary compensation, certificates, and personal letters; encouraging a positive interaction with the field team; holding group meetings to promote "group camaraderie;" sending periodic newsletters; and soliciting participant feedback to improve the study and increase the participants' commitment to it. We have also attempted to document reasons for participant dropout from the studies. In addition to publishing study results in the scientific literature, it is essential that results also be provided to study participants and to the public. In providing study results to participants, we are working closely with the participants so that the results are presented to them in an understandable and useful format and in a timely manner. Part of this work has been funded by the U.S. EPA under assistance agreement #CR-828186-01-0 to Shaw University. It has been subjected to Agency review and approved for publication.

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Leovic, K.W., Williams, R.W., Ejire, A., Sanders, W., Jr., Thornburg, J., and Rhodes, C.E.
Participant recruitment and retention for the NERL RTP PM panel study. Presented at: 11th Annual Meeting of the International Society of Exposure Analysis, Charleston, SC, November 4-8, 2001.

11/4/2001

Contact: Kelly W. Leovic

Abstract: EPA's National Exposure Research Laboratory (NERL) completed a 12 month Particulate Matter (PM) Panel Study in the Research Triangle Park, NC area in May 2001. A primary goal of the study was to compare PM levels measured at an ambient and residential sites with those from personal exposure monitors. The study included two cohorts: 1) 27 African-Americans with controlled high blood pressure living in Southeast Raleigh, and 2) 8 cardiac patients who have an implanted cardiac defibrillator. All 35 participants were at least 50 years old and non-smokers. The study was conducted over four consecutive seasons for 7-days each season for a total of 28 days. Each day of the study, participants were required to wear active and passive personal monitors weighing almost 1,800g attached to a vest, have monitors placed indoors/outdoors at their residences, and complete a time-activity diary. Each participant was compensated \$10/day, plus \$5/day for electricity and \$20 bonus for 26+ days (max of \$440). The participant recruitment/retention target was for 30 participants completing at least three of the four seasons. Participant retention was essential for the study's longitudinal component to be successful. To recruit the 27 African-Americans, we collaborated with Shaw University (a historically black university) on community outreach; letters of support were received from community organizations and leaders; the local media (e.g., NC's African-American newspaper, Raleigh's daily newspaper, TV, community and university radio stations) were informed; Southeast Raleigh churches, community organizations (Wake County Human Services, Strengthening the Black Family, Triangle Family Services, Raleigh area NAACP) were contacted; Shaw University and EPA employees were informed; and flyers were distributed in the community. In the second season, two replacement participants were recruited for the African-American cohort. The eight cardiac patients were recommended by their physician at the University of North Carolina-Chapel Hill and were recruited by direct mailings and follow up phone calls. Research Triangle Institute (RTI) performed the field measurements. Based on participant feedback, a key factor in participant retainment was their very positive interaction with the RTI Field Team throughout the study. Additional activities to promote retention included continued community outreach in Southeast Raleigh by Shaw University; providing framed certificates, personal letters, and phone calls from the Principle Investigator; holding quarterly participant meetings to promote "group camaraderie" and encourage participant feedback; providing study results quarterly based on participant input; and sending quarterly newsletters. A total of 28 participants completed at least three of four seasons: 21 of the 29 African-American participants (27 plus two replacements) and seven of the eight cardiac participants. Thus, 93% of the study target of 30 participants completed at least three of four seasons. Reasons for participant dropout from the study were unrelated health problems (3), scheduling or time problems (2), loss of interest (2), and inability to avoid second-hand smoke (1). This work has been funded wholly by the U.S. EPA under assistance agreement #CR-828186-01-0 to Shaw University and contract 68-D-99-012 to the Research Triangle Institute. It has been subjected to Agency review and approved for publication.

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Norris, G.A., Tolocka, M.P., Williams, R.W., and Rhodes, C.E. Particulate organic carbon measurements collected with low flow personal samplers. Presented at: 11th Annual Meeting of the International Society of Exposure Analysis, Charleston, SC, November 4-8, 2001.

Contact: Ellen W. Streib

Abstract: EPA's National Exposure Research Laboratory and the Research Triangle Institute (RTI) have conducted a particulate matter (PM) personal exposure study in Research Triangle Park, NC. Particulate carbon was sampled with pre-fired quartz filters using low flow PM2.5 samplers (2 LPM, 37 mm filter) in multiple environments: personal, community (ambient), outdoor, and indoor. The quartz filter samples were analyzed for particulate organic carbon (OC) and elemental carbon (EC) using a modified NIOSH Method 5040 protocol by RTI. Pre-fired quartz filters were used to provide a low blank value. However, this laboratory and others have demonstrated that the quartz substrate is an active surface for the collection of semi-volatile organic compounds (SVOCs; McDow et al., 1990; Turpin et al., 1994; Volkens et al., 1999; Tolocka et al., 2001). In this study, SVOC artifact was evident in the personal and indoor samples from a comparison of the particulate carbon mass concentrations with collocated PM2.5 mass concentrations collected with a Teflon filter. The estimated organic mass (OM) was determined by multiplying the OC concentration by 1.4 to account for the hydrogen and oxygen mass not quantified in the carbon analysis. Average personal and indoor OM + EC were 116 % (standard deviation (sd) 62 %) and 135 % (sd 70 %) of the PM2.5 mass concentration, respectively. However, the outdoor OM + EC only explained 47 % of the PM2.5 mass concentration. Indoor or personal monitoring appears to be more highly effected by SVOC artifact due to the prevalence of SVOCs in the indoor environment and the use of samplers with low filter face velocities. The information in this document has been funded wholly or in part by the United States Environmental Protection Agency under Contracts 68-D5-0040 and 68-D-99-012 to Research Triangle Institute, and cooperative agreement CR822981-01 to Research Triangle Institute. It has been subjected to agency review and approved for publication. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

Tulve, N.S., Hore, P., Cohen-Hubal, E.A., Freeman, N.C.G., Lioy, P.J., and Sheldon, L.S. Use of macroactivity approach to assess dermal exposure. Presented at: 11th Annual Meeting of the International Society of Exposure Analysis, Charleston, SC, November 4-8, 2001.

11/4/2001

Contact: Nicolle S. Tulve

Abstract: Currently, data on children's exposures and activities are very limited and insufficient to support quantitative assessments that do not rely heavily on major default assumptions as substitutes for missing information (Cohen Hubal et al. 2000a, b). Cohen Hubal et al. (2000a, b) have identified research needed to reduce this uncertainty, including: collection of activity pattern data for young children required to assess exposure by all routes, and, collection of data on concentrations of environmental contaminants, biomarkers, and transfer coefficients (TCs). One method being evaluated to assess children's dermal exposure to pesticides is the macroactivity approach. In this approach, a child's dermal exposures to chemicals are estimated for each microenvironment where a child spends time and each macroactivity that the child conducts within that specific microenvironment. The total dermal exposure is then modeled by combining surface residue data with empirically-derived TCs specific to each microenvironment/macroactivity combination. The Children's Post-Application Pesticide Pilot Study is a collaborative effort between the EPA and the Environmental and Occupational Health Sciences Institute (EOHSI) in New Jersey. Nine families with young children (<5 years old) were recruited to participate in the study. Homes were monitored for 28 days following a pesticide application. Four-hour videotape segments, time-activity diaries and questionnaires, cotton dosimeters, dermal wipes, and transferable residue loadings were collected during the study. Specific microenvironment and macroactivity combinations for these children were determined from the videotape segments and the time-activity diaries and questionnaires. Transferable residue loadings from the surfaces on which the children spent the majority of their time were measured using a surface sampler (i.e., Lioy-Weisel-Wainman quantitative surface sampler or alcohol wipes). Cotton socks or pajama bottoms were used to calculate potential exposure to pesticide residues through the feet, knees, legs, and bottom. Dermal wipe concentrations, including hands and knees, were also measured. Transferable residues and cotton dosimeter measurements were used to calculate Tcs. TCs were found to depend on the activity level of the child, as well as the surfaces contacted. TC values ranged from 2100 cm²/hr (bottom, quiet play, standing) to 84000 cm²/hr (socks, active play). The lower value is similar to defaults used by EPA's Office of Pesticide Programs: 2600 cm²/hr (intermediate-term) and 5200 cm²/hr (short-term) for 1 to 6 year old children. This work has been funded in part by the United States Environmental Protection Agency under an EPA Technical Services Contract (Contract No. 0D-5227-NAEX) to the Environmental and Occupational Health Sciences Institute. It has been subjected to Agency review and approved for presentation and publication. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

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Akland, G.G., Cohen-Hubal, E.A., Raymer, J.H., Sheldon, L.S., and Pellizzari, E.D. Pesticide screening results from eight daycare centers. Presented at: 11th Annual Meeting of the International Society of Exposure Analysis, Charleston, SC, November 4-8, 2001.

Presented Published

11/4/2001

Contact: Elaine A. Cohen-hubal

Abstract: To improve assessments of children's exposures to pesticides in support of the Food Quality Protection Act, priority research and data needs include: pesticide use patterns, pesticide residue distributions, and dermal exposure assessment approaches. To address these gaps, the National Exposure Research Laboratory of the U.S.EPA is conducting research to develop protocols for applying existing dermal exposure assessment approaches to children in residential and daycare settings. In the process, data are being collected on pesticide use patterns and pesticide distributions following scheduled applications in daycare centers. In this study, the macroactivity approach for assessing dermal exposure is being evaluated. For this approach, dermal exposure is estimated using empirically-derived pesticide transfer coefficients to aggregate the mass transfer associated with a series of contacts with a daycare floor surface. The study was conducted in two phases. In the first phase of this study, eight daycare centers in the Research Triangle Park (RTP) area volunteered to allow field technicians to enter their center and collect transferable residue samples from one classroom the morning following a pesticide application. Samples were collected across the floor of the classroom using three different methods: C-18 press sampler, PUF roller, and surface wipes. Preliminary results from the first phase of this study provide screening data on the pesticides used by daycare centers and the levels of these pesticides on surfaces following an application. Significant analytical challenges were associated with developing a standard multi-residue analysis for the many different pesticides encountered. Results indicate that: o A broad range of pesticides is currently being applied in the RTP area daycare centers (eight different pesticides were applied and measured), o Surface residues measured in areas where children spend time ranged from below the level of detection to over 500 ng/cm². The first phase of this study was used to identify a daycare with easily detectable levels of pesticides. In the second phase of this study nine children in the selected daycare center will be recruited to participate in a pilot monitoring study to test the feasibility of applying the macroactivity approach to assessing dermal exposure of young children in a residential setting. This work has been funded wholly or in part by the United States Environmental Protection Agency under contract no. 68-D-99-012 to Research Triangle Institute. It has been subjected to Agency review and approved for publication.

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Nishioka, M.G., Cohen-Hubal, E.A., Ivancic, W., Andrews, K., and Sowry, J. Dermal and mouthing transfers of surface residues measured using fluorescence imaging. Presented at: 11th Annual Meeting of the International Society of Exposure Analysis, Charleston, SC, November 4-8, 2001.

Contact: Elaine A. Cohen-hubal

Abstract: To reduce the uncertainty associated with current estimates of children's exposure to pesticides by dermal contact and non-dietary ingestion, residue transfer data are required. Prior to conducting exhaustive studies, a screening study to develop and test methods for measuring residue transfers and to identify the important parameters for characterizing these transfers was conducted. Two different quantitative fluorescence measurement techniques were developed so that dermal and mouthing contact transfers could be assessed with a non-toxic surrogate for pesticides. Contact/mouthing surfaces included nylon carpeting, laminate flooring, and toys. These surfaces were sprayed with highly fluorescent riboflavin (water-soluble Vitamin B2) at levels approximating post-application pesticide residue levels, and allowed to dry completely before dermal or mouthing contact experiments. The first method, quantitative video fluorescence imaging analysis, was developed for in-situ measurement of trace levels of riboflavin on hands following contact with the carpet or laminate surface. Subjects (n=3) contacted these surfaces with one of 24 combinations of contact parameters, including duration, pressure, and skin moisture. Overall, transfer for initial contact averaged 2.6% and transfer for multiple contacts averaged 6.3%. Hand washing removed 30-90% of residues; contacting a clean surface removed <15%. The second method, involving extraction and spectrofluorimetry analysis, was developed to measure the trace levels of riboflavin removed from the surface of a treated toy by a simulated mouth that consisted of polyurethane foam (PUF) strips wrapped around three fingers and moistened with a surrogate saliva. Subjects (n=3) "mouthed" hard, soft and plush toys with one of 24 combinations of contact parameters, including pressure, duration and mouthing motion. Overall, transfers averaged 48%, with a low of 10-20% for mouthing plush toys, and a high of 100% for sucking on hard toys. Experiments were also conducted to assess relative transfers of riboflavin and the pesticides chlorpyrifos and allethrin from treated carpet and laminate surfaces to transfer sampling devices that rely on either a polyurethane foam sleeve (the PUF Roller) or an Empore C18 disk (the Press Sampler). From carpets, transfer efficiencies for chlorpyrifos and riboflavin were similar, ~0.3% with the PUF Roller and ~0.04% with the Press Sampler. From laminates, riboflavin transfer was about 10X higher than chlorpyrifos transfer, with transfer to PUF of ~2% and transfers to C18 of ~1%. Further work is being conducted to better characterize the relationship between transfer of tracer and pesticides. This work has been funded wholly or in part by the United States Environmental Protection Agency under contract No. 68-D-99-011 to Battelle. It has been subjected to Agency review and approved for publication. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

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Cohen-Hubal, E.A., Akland, G.G., Raymer, J.H., Pellizzari, E.D., and Sheldon, L.S. Development and evaluation of an aggregate surface sampling method for use in assessing dermal exposures of young children. Presented at: 11th Annual Meeting of the International Society of Exposure Analysis, Charleston, SC, November 4-8, 2001.

11/4/2001

Contact: Elaine A. Cohen-hubal

Abstract: In the macroactivity approach, dermal exposure is estimated using empirically-derived transfer coefficients to aggregate the mass transfer associated with a series of contacts with a contaminated medium. The macroactivity approach affords the possibility of developing screening level exposure assessments in a shorter time frame and with fewer resources than would be required for the microactivity approach (in which dermal exposure is explicitly modeled as a series of discrete transfers resulting from each contact with a contaminated medium). Current techniques for applying pesticides indoors at homes and schools, such as along walls, doors, and sinks, result in a nonuniform distribution of pesticide. To use the macroactivity approach a representative measure of surface contaminant loading is required.

As part of a larger study to test the feasibility of applying the macroactivity approach to estimate children's residential exposures to pesticide contaminated surfaces, we are developing and testing a method for collecting an aggregate measure of surface loading. The following approach was used to develop and test an aggregate-surface-loading measurement method. Daycare centers were recruited and one classroom from each was selected for surface sampling following a known pesticide application. Ten sampling points were selected to include the types of surfaces and locations that children contact during their normal activities. Individual C-18 press samples were collected at each location. In addition, two aggregate samples were collected using one C-18 disk for each of five locations, and one aggregate sample collected using one C-18 disk at all ten locations. In three of the sampling locations, a PUF roller sample and wipe sample were also collected to facilitate development of an empirical database for method comparison and modeling. Using the database, the surface concentration distribution was modeled using a geo-statistical model, and an average estimated surface concentration developed. The resulting data will form the basis for constructing a protocol for obtaining a spatial average of the transferable residue across the classroom. Results obtained from sampling in eight different daycare centers and for different pesticides will be presented.

This work has been funded wholly or in part by the United States Environmental Protection Agency under contract no. 68-D-99-012 to Research Triangle Institute. It has been subjected to Agency review and approved for publication.

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Vette, A.F., Williams, R.W., Riediker, M., and Thornburg, J. Particle size distributions from select residences participating in the NERL RTP PM panel study. Presented at: 11th Annual Meeting of the International Society of Exposure Analysis, Charleston, SC, November 4-8, 2001.

Contact: Ronald W. Williams

Abstract: Particle Size Distributions from Select Residences Participating in the NERL RTP PM Panel Study. Alan Vette, Ronald Williams, and Michael Riediker, U.S. Environmental Protection Agency, National Exposure Research Laboratory, Research Triangle Park, NC 27711; Jonathan Thornburg, Research Triangle Institute, Research Triangle Park, NC 27709. Particle size distributions were measured indoors and outdoors of four residences during the Research Triangle Park (RTP) Particulate Matter (PM) Panel Study sponsored by the U.S. EPA National Exposure Research Laboratory (NERL). The objective of this research was to assess the factors affecting particle concentrations in the indoor environment, including characterizing indoor sources of PM and infiltration of PM originating outdoors. Size resolved particle number concentrations were measured using a Scanning Mobility Particle Spectrometer (SMPS; TSI Model 3936) and an Aerodynamic Particle Sizer (APS; TSI Model 3320). Indoor and outdoor aerosol concentrations were alternately measured through a ball-valve switching manifold. Concurrent measurements of indoor air exchange rates were made continuously by releasing sulfur hexafluoride and monitoring concentration decay using a portable gas chromatograph (Lagus Applied Technologies). Data were collected from four homes in an environmental justice area in southeast Raleigh, NC over multiple seasons. Monitoring took place during fall 2000 (1 home), winter 2001 (4 homes), and spring 2001 (3 homes). Although the houses were located within 5 km of each other, they varied considerably in size (between one and two story; 1000 ? 2500 square feet), construction (brick or wood siding) and age (24 ? 42 years). Results from all of the houses show that infiltration of ambient particles between 0.1 and 1 micrometer was the predominate source of indoor particles with periodic episodes of elevated particle concentrations due to cooking. In general, indoor/outdoor particle concentration ratios were highest for particles between 0.1 and 1 micrometer during non-source periods. Average indoor/outdoor ratios in this size region varied considerably from about 0.5 to 0.9, both between homes and within the same home during different seasons. Cooking sources included frying and baking, which generated particles primarily in the ultrafine size range (<0.1 micrometer). Hourly air exchange rates varied between homes and seasons, and generally ranged from about 0.5/h to 3/h. This work has been funded wholly or in part by the United States Environmental Protection Agency under Contract No. 68-D99-012 to the Research Triangle Institute. It has been subjected to Agency review and approved for publication. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

Thomas, K.W., Sheldon, L.S., Gordon, S.M., Reynolds, S., Lynch, C., and Alavanja, M. Agricultural health study/pesticide exposure study: year 1 measurement results. Presented at: International Conference of Pesticide Exposure and Health, Bethesda, MD, December 17-21, 2001.

12/17/2001

Contact: Ellen W. Streib

Abstract: The Agricultural Health Study is a prospective epidemiologic study of pesticide applicators and their spouses in Iowa and North Carolina. Exposure to 2,4-D or chlorpyrifos is being measured for a subset of applicators to assess exposure classification procedures. Applicators are selected based on their use of selected application methods and personal protective equipment. Potential exposures are measured on one day of pesticide mixing, loading, and application activities. Urinary biomarker levels are measured in pre- and post-application samples from each applicator and for participating spouses and children. Measurements were completed for ten Iowa private pesticide applicators during the first year of the study (2000). Potential dermal exposure was measured by placing ten cellulose or gauze patches on the body. Patches were combined for analysis. Dermal patch measurement results ranged from 7 to 1100 g/sample for eight 2,4-D applicators that used spray application methods, and 2 g/sample for two chlorpyrifos applicators that applied a granular product. Hand wipe samples were collected using a sub-sampling method that wipes approximately 10% of the hand surface area. Hand wipe measurement results ranged from 3 to 1400 g/sample for the 2,4-D applicators. Post-application levels of 2,4-D in urine ranged from 4 to 110 g/g creatinine for 2,4-D applicators. Urinary levels of the 3,5,6-trichloropyridinol (TCP) metabolite of chlorpyrifos were 4 g/g creatinine for the two chlorpyrifos applicators. Urinary levels of 2,4-D were <10 g/g (2,4-D) and <4 g/g (TCP) for participating spouses and children. This work has been funded in part by the U.S. Environmental Protection Agency. It has been subjected to Agency review and approved for publication. Mention of trade names of commercial products does not constitute endorsement or recommendation for use.

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12/17/2001

Cohen-Hubal, E.A., Akland, G.G., Leovic, K.W., Raymer, J.H., and Sheldon, L.S. Feasibility of using the macroactivity approach to assess children's dermal exposure to pesticides. Presented at: SOEH International Conference of Pesticide Exposure and Health, Bethesda, MA, December 17-21, 2001.

Contact: Elaine A. Cohen-hubal

Abstract: Results derived from an initial assessment of critical exposure pathways for children indicate that dermal contact may result in high residential exposures to pesticides. However, data on children's exposures and activities are insufficient to support quantitative assessments that do not rely heavily on major default assumptions as substitutes for missing information. In addition, approaches for measuring and assessing dermal exposure in a residential setting have not been evaluated. In the macroactivity approach, dermal exposure is estimated using empirically-derived transfer coefficients. This approach was developed to assess occupational exposure in an agricultural setting. To assess the feasibility of using the macroactivity approach for assessing children's exposure to pesticides, a screening-level study was conducted with young children in a daycare center where a known pesticide application had occurred. Four or five children from each of two different age groups were monitored for short time periods while involved in selected activities (e.g., storytime, playtime indoors). To measure dermal loading or exposure, the children were clothed in full-body dosimeters. To measure the pesticide concentration in the exposure medium, transferable residues were sampled in the areas where the children spent time during each monitoring event. In addition, videotaping was conducted to verify the children's activity levels and location during exposure monitoring. The dermal loading and transferable residue measurements were then used to calculate dermal transfer coefficients for each monitoring event. The results of this study demonstrate the variability of dermal loading (and associated transfer coefficients) for children of a given age group performing varying activities. In addition, these data will be used to evaluate the default assumptions currently used by USEPA's Office of Pesticide Programs to assess children's residential exposure to pesticides.

This work has been funded wholly or in part by the United States Environmental Protection Agency under contract no. 68-D-99-012 to Research Triangle Institute. It has been subjected to Agency review and approved for publication.

Sheldon, L.S., Cohen-Hubal, E.A., and Fortmann, R.C. The EPA children's pesticide exposure measurement program. Presented at: Workshop on Exposure of Children to Pesticides, Berlin, Germany, September 27-29, 2001.

9/26/2001

Contact: Linda S. Sheldon

Abstract: The U.S. EPA's National Exposure Research Laboratory conducts research in support of the Food Quality Protection Act (FQPA) of 1996. FQPA requires that children's risks to pesticide exposures be considered during the tolerance-setting process. FQPA requires exposure assessments to be conducted for all potential sources, routes and pathways, not just dietary intake. It also requires that exposure assessments use high quality and high quantity exposure data or models based on exposure factors generated from existing, reliable data.

Currently, data on children's exposures and activities are very limited and insufficient to support quantitative assessments that do not rely heavily on major default assumptions as substitutes for missing information. Results derived from an initial assessment of critical exposure pathways and factors for assessing children's residential exposures to pesticides indicate that dermal exposure and nondietary ingestion may result in high exposures for children following residential applications. However, there are so few data associated with these pathways that exposure estimates may vary by orders of magnitude, depending upon the assumptions and exposure factors selected. Studies across all ages of children, but especially for very young children, are required to characterize activities that contribute to dermal exposure in important microenvironments. Studies are also needed to characterize contact and transfer factors for non-dietary ingestion. The goal of our program is to develop and evaluate protocols for assessing children's aggregate exposure to pesticides, and to conduct fields studies to collect data required to reduce the reliance on default assumptions in development of quantitative exposure assessments. To address this goal, studies are being conducted in the following areas: 1. Microenvironment/macroactivity patterns for children; 2. Pesticide use patterns; 3. Distribution of pesticide residues in nonoccupational microenvironments; 4. Exposure measurements using the microactivity assessment approach; 5. Exposure assessments using the macroactivity assessment approach; and 6. Field studies to verify assessment methods. A review and outputs of specific studies will be presented. This work has been funded wholly or in part by the United States Environmental Protection Agency under contract nos. 68D99011 to Battelle and 68D990112 to Research Triangle Institute. It has been subjected to Agency review and approved for publication.

Jan 1, 2001 - Dec 31, 2001

Presented Published

Fortmann, R.C. The EPA/ORD/NERL's Human Exposure Measurements Program - children's focus. Presented at: Non-Dietary Exposure Task Force Information Meeting, Fort Lauderdale, FL, December 4, 2001.

12/4/2001

Contact: Ellen W. Streib

Abstract: The U.S. EPA's National Exposure Research Laboratory (NERL) conducts research in support of the Food Quality Protection Act (FQPA) of 1996. FQPA requires that children's risks to pesticide exposures be considered during the tolerance-setting process. The Act requires exposure assessments to be conducted for all potential sources, routes and pathways, not just dietary intake. It also requires that exposure assessments use high quality and high quantity exposure data or models based on exposure factors generated from reliable data. Data on children's exposures and activities are currently very limited and insufficient to support quantitative assessments that do not rely heavily on major default assumptions as substitutes for missing information. Studies are required to characterize indoor pesticide sources, exposure pathways, the impact of children's activities on exposure, and children's aggregate exposures to pesticides by all routes and pathways for all ages of children, but especially for very young children. The goal of the NERL program is to develop and evaluate protocols for assessing children's aggregate exposure to pesticides, and to conduct fields studies to collect data required to reduce the reliance on default assumptions in development of quantitative exposure assessments. To address this goal, studies are being conducted in the following areas: Spatial and temporal distribution of pesticide residues in indoor environments (residences, daycares, schools), Pesticide use patterns indoors, Dermal exposure measurements using microactivity and macroactivity assessment approaches, Indirect ingestion exposure measurements, Microenvironment/macroactivity patterns for children, Protocol and methods development for aggregate exposure measurements, and Field studies to verify assessment methods and collect exposure concentration and exposure factor data. This presentation provides an overview of the NERL children's exposure measurement program, the goals, technical approach, descriptions of on-going studies, and plans for a future longitudinal children's pesticide exposure study. This work has been funded wholly or in part by the United States Environmental Protection Agency under contract nos. 68-D-99-011 to Battelle and 68-D-99-012 to Research Triangle Institute. It has been subjected to Agency review and approved for publication.

Robertson, G.L., Reses, J., Nishioka, M.G., and Lebowitz, M.D. Concentrations of pesticide from dermal surfaces: a comparison of NHEXAS & AZ border samples. Presented at: 11th Annual Meeting of the International Society of Exposure Analysis, Charleston, SC, November 4-8, 2001.

11/4/2001

Contact: Gary L. Robertson

Abstract: NHEXAS-AZ was a statewide survey designed to gather data on the distributions of exposure from various media. Results of intensive sampling were obtained from 179 homes. Border-AZ was a similar study focusing on homes within 40 km of the Arizona-Mexico Border; similar results were obtained from 87 homes. Our focus was to examine the differences in the concentrations of chlorpyrifos, diazinon, and malathion on dermal surfaces between NHEXAS-AZ and Border-AZ, and to compare differences by county and correlate these to concentrations obtained from various media. Dermal concentrations of pesticides appear to have a greater range and value across the state compared to the border regions; however, median values were similar to or greater along the border. Dermal pesticides collected from the border region were variable. Diazinon and DDE were significantly elevated in Yuma County compared to Cochise and Santa Cruz counties, while chlordane was significantly elevated in Santa Cruz County. All other pesticide values were similar across counties. Dermal concentrations of pesticides were significantly correlated with concentrations from indoor air and floor dust values. The greater range and values of dermal pesticides found in NHEXAS households relative to Border homes is likely due to increased variability and use of home-based pesticide products; however, the similarity between the median values suggests that the majority of homes may be exposed to pesticides similarly. Variation of dermal pesticides between counties may be due to agricultural use patterns while significant correlations with air and floor dust values suggest that exposure may primarily be through these routes. This research was funded by the United States Environmental Protection Agency (CR 821560 & 824719). This abstract has been subjected to Agency review and approved for presentation.

Jan 1, 2001 - Dec 31, 2001

Presented Published

Hern, S.C., Bronson, D., Osgood, D., Rosales, C., and O'Rourke, M.K. Modeling of macroscale agricultural elements in pesticide exposure. Presented at: 11th Annual Meeting of the International Society of Exposure Analysis, Charleston, SC, November 4-8, 2001.

11/4/2001

Contact: Stephen C. Hern

Abstract: Yuma County, Arizona, is the site of year around agriculture. To understand the role of agricultural pesticide exposures experienced by children, urinary metabolite concentrations were compared with agricultural use of pesticides. The urinary metabolite and household data were taken from the Children's Pesticide Study in Yuma County. The regional pesticide application data were obtained from the Arizona Department of Agriculture 1080 form. Data were examined using geospatial analysis (ArcInfo). Chlorpyrifos, an organophosphate insecticide used in conjunction with permethrin on broccoli, can be specifically detected by the presence of a metabolite, 3,5,6-trichloro-2-pyridinol (TCPY), in urine. Chlorpyrifos exposure (TCPY) was compared with macroscale pesticide use. In anticipation of observing seasonal differentiation, the data were examined for seasonal trends. Chlorpyrifos exhibited a bimodal trend with peaks in the spring and fall. A preliminary linear regression examined monthly levels of agricultural chlorpyrifos application and TCPY observed in urine samples. The association was not significant ($p = 0.669$). An examination of creatinine-adjusted dimethylphosphate (DMP) levels in the urine was significantly correlated to agricultural use of dimethoate, methidathion, and malathion ($p = 0.002$), but this significance is being driven by a single observation. Other variables must therefore play an important part in pesticide exposure. The pesticide exposure potential (PEP) will be an aggregate of macroscale agricultural exposure, and microscale exposures integrated through the child, and represented by the TCPY measurement. Microscale exposures include paraoccupational exposure and the use of pesticides in and around the home. Better assessment of the macroscale agricultural exposure involved creating a model incorporating the distance between households and the point of pesticide application, a host of weather variables including wind direction and temperature, and environmental half-life measures for the pesticides. This model was then used to predict metabolite levels in a spatial array of regional urine samples taken by the Centers for Disease Control and Prevention. This research was funded by the United States Environmental Protection Agency (#825169) and ADHS (#161037). This abstract has been subjected to Agency review and approved for presentation.

Van Emon, J.M., Brumley, W.C., Reed, A.W., and Chuang, J.C. Human exposure assessment using immunoassay. Presented at: American Chemical Society 221st National Meeting, Immunochemistry Summit IX Symposium, San Diego, CA, April 1-5, 2001.

4/1/2001

Contact: Jeanette M. Van emon

Abstract: The National Exposure Research Laboratory-Las Vegas is developing analytical methods for human exposure assessment studies. Critical exposure studies generate a large number of samples which must be analyzed in a reliable, cost-effective and timely manner. TCP (3,5,6-trichloro-2-pyridinol) is a urinary metabolite and environmental degradation product of the insecticide chlorpyrifos (O,O-diethyl-O-[3,5,6-trichloro-2-pyridyl]-phosphorothioate). Enzyme-linked immunosorbent assays (ELISAs) have been developed and evaluated to detect low-level TCP in food and urine. Samples from dietary exposure studies and human exposure surveys were analyzed by the ELISA and gas chromatography/mass spectrometry (GC/MS). The limit of detection for the ELISA is 0.1 ppb in diluted food and hydrolyzed urine extracts. Comparative studies with GC/MS indicate a good correlation between the two methods for low ppb levels. Samples from occupational and nonoccupational exposure studies yielded correlations of $r=0.990$ and $r=0.970$, respectively. This work has been funded wholly or in part by the U.S. EPA under Contract 68-D99-011 Battelle. It has been subjected to Agency review and approved for publication. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

Jan 1, 2001 - Dec 31, 2001

Presented Published

4/1/2001

Van Emon, J.M., Brumley, W.C., and Reed, A.W. Elegant environmental immunoassays. Presented at: American Chemical Society 221st National Meeting, Immunochemistry Summit IX Symposium, San Diego, CA, April 1-5, 2001.

Contact: Jeanette M. Van emon

Abstract: Immunochemical methods are based on selective antibodies directed to a particular target analyte. The specific binding between antibody and analyte can be used for detection and quantitation. Methods such as the enzyme-linked immunosorbent assay (ELISA) can provide a sensitive, specific, simple to perform, and cost-effective analysis for many compounds of environmental and human health concern. ELISAs can be designed as rapid field screening, semi-quantitative analysis or as quantitative laboratory procedures. Thus, immunochemical methods are responding to the analytical challenges of environmental monitoring and regulatory programs. Advancements in environmental immunoassays have expanded their role from field screening methods to highly quantitative procedures that can compete with chromatographic methods in the laboratory. This progression of environmental immunoassays was initiated by field trials such as those performed under the U.S. EPA Superfund Innovative Technology Evaluation (SITE) Program. Several of these SITE studies have been conducted by the NERL-Las Vegas laboratory. The first of these trials determined the performance of two pentachlorophenol immunoassays in comparison to a gas chromatography (GC) procedure. Much was learned from this first field trial including appropriate quality control measures, data comparability concerns, and how to perform a sensitive analytical method at a contaminated site. Immunoassays have now evolved as rapid and reliable methods to support human exposure assessment studies for pesticide residues, environmental degradation products, and metabolites. Immunoassays to detect chlorpyrifos (O,O-diethyl-O-[3,5,6-trichloro-2-pyridyl]-phosphorothioate and its metabolite TCP (3,5,6-trichloro-2-pyridinol) in food, track-in dirt, house dust and urine have been applied to samples from occupational and nonoccupational exposure surveys. The immunoassays performed comparably with gas chromatography/mass spectrometry (GC/MS) methods at low ppb levels; however, sample preparation was minimal with a high sample throughput and at a lower cost. This work has been funded wholly or in part by the U.S. Environmental Protection Agency and has been approved for publication. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

Robertson, G.L., Petty, J.D., Gale, R.W., Cranor, W.L., and Huckins, J.N. A survey of indoor air contaminants using semipermeable membrane devices. Presented at: AWMA Annual Conference, Orlando, FL, June 24-28, 2001.

6/24/2001

Contact: Gary L. Robertson

Abstract: Semipermeable membrane devices (SPMDs) were deployed in indoor areas in approximately 50 residences along the border between Arizona and Mexico to measure airborne contaminants. The results of the primary analyses and gas chromatographic/mass spectrometric confirmation for organochlorine pesticides, polychlorinated biphenyls, and polynuclear aromatic hydrocarbons has been previously reported. In this abstract the results of the investigation of non-target analytes in the organochlorine fraction are described. This extract is also the most probable chromatographic fraction to contain the broadest spectrum of bioconcentrateable chemicals sequestered from the indoor air. Approximately 400 individual components were identified in this fraction. About 289 components were tentatively identified from the mass spectra, with another 117 unidentified components. These airborne chemicals ranged from the chemicals previously confirmed and reported to a wide array of hydrocarbons to fragrances such as musk xylenes to flavors relating to spices to aldehydes, alcohols and esters, and a variety of miscellaneous types of chemicals. These chromatographic fractions were processed in a very rigorous manner to minimize interferences in the mass spectrometric analysis. Consequently, it is likely that other chemicals were lost or their concentrations greatly reduced. The results, however, demonstrate that the mixture of airborne chemicals present in the indoor residential areas sampled is far more complex than generally reported. Additional research is needed to more thoroughly characterize these very complex mixtures of airborne chemicals and evaluate the human exposure to them. The U.S. EPA Office of Research and Development funded this research. The abstract was reviewed and approved. The presentation has not been reviewed.

Jan 1, 2001 - Dec 31, 2001

Presented Published

Rogers, K.R., Ramanathan, K., and Apostol, A.B. Detection of DNA damage using melting analysis techniques. Presented at: Chemical Sensors and Interfacial Design Conference, Ciocco, Italy, May 6-11, 2001.

5/6/2001

Contact: Kim R. Rogers

Abstract: A rapid and simple fluorescence screening assay for UV radiation-, chemical-, and enzyme-induced DNA damage is reported. This assay is based on a melting/annealing analysis technique and has been used with both calf thymus DNA and plasmid DNA (puc 19 plasmid from E. coli). DNA damage resulting from exposure to UV-C and UV-A radiation, several restriction endonucleases, and several classes of DNA damaging compounds can be measured. Based on a similar melting/annealing analysis concept, a rapid and sensitive fiber optic biosensor assay for ionizing radiation-induced DNA damage is also reported. For this assay, a biotin-labeled capture oligonucleotide (38 mer) was immobilized to an avidin-coated quartz fiber. Hybridization of a dye-labeled complementary sequence was observed using the evanescent wave and reported at the proximal end of the optical fiber. Changes in temperature-induced strand separation were then used as a sensitive indicator of damage resulting from exposure of the dye-labeled strand to low doses of ionizing radiation. Ten assays (each requiring about 15 min) could be run on the same fiber. Radiation exposures of between 0.2 and 10 Gray (Gy) were measured. The U.S. Environmental Protection Agency (EPA), through its Office of Research and Development (ORD), has funded this research and approved this abstract as a basis for a presentation.

Van Emon, J.M. Evolution of environmental immunochemistry. Presented at: 22nd American Chemical Society National Meeting, Chicago, IL, August 26-30, 2001.

8/26/2001

Contact: Jeanette M. Van emon

Abstract: Enzyme-linked immunosorbent assays (ELISAs), initially developed for clinical applications, have made a tremendous impact as clinical diagnostic indicators. Pesticide chemists became attracted to the potential of these sensitive and selective methods in the 1970s. Thus, began the transition of immunochemical technology to environmental monitoring. Immunoassays are now providing cost-effective analyses for many compounds of environmental and human health concern. Methods range from highly quantitative laboratory procedures to rapid field analyses. Immunoassay methods are available for numerous pesticides (i.e., paraquat; chlorpyrifos; 2,4-D), pesticide metabolites, and environmental contaminants (i.e., pentachlorophenol, and polychlorinated biphenyls). Immunoassay data are used to assist in monitoring cleanup activities at waste sites, and to support human exposure assessment studies. A brief history of environmental immunoassays, current applications developed or evaluated by the EPA, National Exposure Research Laboratory-Las Vegas, and future research needs and possibilities will be presented. This work has been funded wholly or in part by the U.S. Environmental Protection Agency and has been approved for publication. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

Jan 1, 2001 - Dec 31, 2001

Presented Published

Robertson, G.L., Quackenboss, J.J., Hern, S.C., and Thompson, C.B. The human exposure database system (HEDS)-putting the NHEXAS data on-line. Presented at: 11th Annual Meeting of the International Society of Exposure Analysis, Charleston, SC, November 4-8, 2001.

11/4/2001

Contact: Gary L. Robertson

Abstract: The EPA's National Exposure Research Laboratory (NERL) has developed an Internet accessible Human Exposure Database System (HEDS) to provide the results of NERL human exposure studies to both the EPA and the external scientific communities. The first data sets that will be available are results from the National Human Exposure Assessment Survey (NHEXAS) pilot/demonstration studies in Arizona, Maryland, and EPA Region 5. The system is scheduled to be on-line through the EPA public Web site by September 30, 2001. The data will include analytical chemistry data for media such as air, soil, drinking water, house dust, food, beverage, blood, and urine. The analyte classes include pesticides, metals, volatile organic compounds (VOC), and polynuclear aromatic hydrocarbons (PAH). Not all media and analytes were tested in each study nor by all participants in a single study. Questionnaire and diary responses are also included. These address residential, life style, demographic, occupational, and health characteristics, time/activity patterns, and food consumption information. Population based weighting information is also provided. A data dictionary and code table is provided to define the contents for each data table. In addition, detailed documentation regarding each study's design and methods is provided to help the user interpret the data. The Quality System Implementation Plan (QSIP) for each study is provided as are the Standard Operating Procedures (SOP) for collecting, processing, storing, and analyzing the samples. These include field sampling procedures, analytical methods, questionnaire administration, participant selection, data review and storage, etc. HEDS is also tightly interfaced with EPA's Environmental Information Management System (EIMS) which contains a metadata record for each data table and document available in HEDS. The EIMS metadata record contains an abstract, other information, and a link to download the data table or document. EIMS is searchable to make the desired information easy to locate. HEDS will be described in detail, examples of the various types of data will be provided and procedures for using HEDS will be discussed. This work has been funded wholly or in part by the United States Environmental Protection Agency under IAG number DW47789701 to the General Services Administration and has been approved for publication. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

Bennett, D.H., and Furtaw, Jr., E.J. A fugacity-based indoor residential pesticide fate model. Presented at: 11th Annual Meeting of the International Society of Exposure Analysis, Charleston, SC, November 4-8, 2001.

11/4/2001

Contact: Edwin J. Furtaw

Abstract: Dermal and non-dietary pathways are potentially significant exposure pathways to pesticides used in the home. Exposure pathways include dermal contact of pesticide residues with the hands and skin, ingestion from hand-to-mouth activities, ingestion through contact with toys and other items, and absorption of pesticides into food. A limited amount of data has been collected on pesticide concentrations in various media in the home following an application; however, a model is needed that can predict concentrations of other pesticides based on their chemical properties. A model based on fugacity principles is presented in this talk. The compartments included in the mass-balance model are the air (both gas phase and aerosols), carpet, smooth flooring, and walls. Pesticide concentrations on furniture and toys, and in food, are also considered, as these are possible exposure media. Compartmental fugacity capacities and mass transfer-rate coefficients between compartments are calculated and used in a dynamic mass-balance model. Concentrations predicted by the model are compared to measured concentrations found in homes following an application. This work has been funded in part by the United States Environmental Protection Agency under Interagency Agreement No. DW-89938190 with Lawrence Berkeley National Laboratory. It has been subjected to Agency review and approved for publication.

Jan 1, 2001 - Dec 31, 2001

Presented Published

Bennett, D.H., and Furtaw, Jr., E.J. The indoor fugacity model. Presented at: Society of Environmental Toxicology and Chemistry 2001 Annual Meeting, Baltimore, MD, November 11-15, 2001.

11/11/2001

Contact: Edwin J. Furtaw

Abstract: Dermal and non-dietary pathways are potentially significant exposure pathways to pesticides used in the home. The exposure pathways include dermal contact through the hands and skin, ingestion from hand to mouth activities, ingestion through contact with toys and other items, and absorption of pesticides into food. A limited amount of data has been collected on pesticide concentrations in the home following an application; however, a model is needed that can predict concentrations of other pesticides based on their chemical properties. A model based on fugacity principles is presented in this talk. The compartments included in the mass balance are the air (both gas phase and aerosols), carpet, smooth flooring, and walls. The concentrations on furniture and toys, and in food, are also considered as these are possible exposure media. The fugacity capacity and transfer rate coefficients between compartments are calculated and used in a dynamic mass-balance model. The concentrations predicted by the model are compared to measured concentrations found in homes following an application. This work has been funded in part by the United States Environmental Protection Agency under Interagency Agreement No. DW-89938190 with Lawrence Berkeley National Laboratory. It has been subjected to Agency review and approved for publication.

Sohn, M.D., McKone, T.E., Rigas, M.L., Blancato, J.N., Power, F.W., and Tsang, A.M. Reconstructing exposure scenarios using dose biomarkers - an application of bayesian uncertainty analysis. Presented at: International Society of Exposure Analysis Annual Meeting, Charleston, SC, November 4-8, 2001.

11/4/2001

Contact: Marc L. Rigas

Abstract: We use Bayesian uncertainty analysis to explore how to estimate pollutant exposures from biomarker concentrations. The growing number of national databases with exposure data makes such an analysis possible. They contain datasets of pharmacokinetic biomarkers for many pollutants (e.g., CDC National Health and Nutrition Examination Survey (NHANES)) and detailed information about human activity and consumption patterns (e.g., the EPA National Human Exposure Assessment Survey (NHEXAS), the EPA National Human Activity Pattern Survey (NHAPS), and the USDA national survey of food and water consumption). However, variability and uncertainty in the assessed information, and in estimated (or predicted) pollutant concentrations in foods, air, water, and soils, complicates the determination of unique links between biomarkers and exposures. Moreover, biomarkers only provide snap-shots of exposure events and may not describe their temporal history. Thus, reconstructing exposure scenarios, and assessing their quality, must include each component of the exposure-to-biomarker concentration relationship. We explore these issues using a Bayesian uncertainty analysis framework. A physiologically-based pharmacokinetic (PBPK) model is linked with an indoor air model, and variability (or uncertainty) in each is evaluated. The Bayesian framework allows us flexibility for evaluating multiple exposure scenarios and alternative datasets, simultaneously. Using surrogates for volatile and semi-volatile chemicals, we demonstrate how reconstructed exposure scenarios can contain great uncertainties, even with well-documented human activity and biomarker information. We also present preliminary findings of our ongoing work to determine: (i) what exposure assessment information is useful in the reconstructions; (ii) what information, other than those commonly gathered in exposure assessments, could improve them; and (iii) how quality and quantity of data affects the reconstructions, thereby assisting future data gathering. For example, we find that uncertainty in describing metabolism has great impact on estimates of exposure to volatile organic compounds, like trichloroethylene. We also find that since body weight and breathing rate variability is well-described in the surveys, additional information will not significantly improve exposure estimates; in contrast, additional information about still highly uncertain exposure factor like dermal contact duration may significantly improve them. This work has been funded in part by the United States Environmental Protection Agency under Interagency Agreement No. DW-89938190 with Lawrence Berkeley National Laboratory. It has been subjected to Agency review and approved for publication.

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Presented Published

11/4/2001

Quackenboss, J.J., Sheldon, L.S., Hammerstrom, K., Robertson, G.L., Hern, S.C., and Leovic, K.W. An overview of the National Human Exposure Assessment Survey (NHEXAS) Phase I studies. Presented at: 11th Annual Meeting of the International Society of Exposure Analysis, Charleston, SC, November 4-8, 2001.

Contact: James J. Quackenboss

Abstract: The National Human Exposure Assessment Survey (NHEXAS) Phase I studies were sponsored by EPA's Office of Research and Development (ORD) to address critical information needs for assessing human exposures to multiple chemicals from multiple pathways and media. These studies were implemented with extensive research collaboration, including scientists from leading academic research institutions, the EPA, CDC, and other federal agencies. Key goals for the first phase of NHEXAS included evaluating the feasibility to conduct a complex measurement study with representative populations, documenting population distributions of exposure, understanding factors that contribute to human exposures, and improving the accuracy of exposure models. These studies measured distributions of human exposures to a variety of high-risk target chemicals, including metals, volatile organic compounds (VOCs), and pesticides. In these studies, approximately 500 volunteer participants were randomly selected from three areas of the country: the state of Arizona, the greater Baltimore, Maryland area, and the EPA Region 5 states (IL, IN, MI, MN, OH, and WI). Measurements were made of the air people breathed, the foods and beverages they consumed, and the dust and soil in/near their home. Measurements were also made of chemicals or their metabolites in biological samples, including blood and urine. The participants completed questionnaires to help identify possible sources of exposures and to characterize activities that might contribute to exposure. Individual investigators were able to use alternative and innovative approaches to conduct multimedia measurements, and were able to target some specific concerns or hypotheses to be investigated in each study. Two of the groups focused on representing exposures of larger populations at one time, while another group studied fewer people but repeated the measurements six times over the year to examine temporal variability for the exposures and activities of interest. The NHEXAS studies have provided unique information on the range of actual exposures in the general population for three areas of the U.S. for use as "benchmarks" in site-specific investigations and for health risk assessments. The data have also been analyzed to characterize differences in exposure between demographic groups, to compare exposure measurements and the biomarkers, and to evaluate changes in exposures over time. Following a recommendation from EPA's Science Advisory Board (SAB), the EPA developed a strategy to identify and prioritize additional analyses. EPA held a workshop to obtain a wide range of expert opinion regarding scientific analyses necessary to interpret the NHEXAS data. In addition, the NHEXAS databases and protocols are being made publicly available, and "lessons learned" and recommendations for future studies are being documented. These include a broad range of activities required for large scale exposure studies: project leadership, design, survey operations, field sampling, analytical laboratories, database development, quality assurance, and communication of results. This information will be critical in effectively designing and implementing future large scale human exposure surveys. This work has been funded wholly or in part by the United States Environmental Protection Agency. It has been subjected to Agency review and approved for publication.

Jan 1, 2001 - Dec 31, 2001

Presented Published

Maykut, N., Lewtas, J., and Larson, T.V. Source apportionment of PM 2.5 and carbon in Seattle using chemical mass balance and positive matrix factorization. Presented at: AWMA/AGU International Specialty Conference, Bend, OR, October 2-5, 2001.

10/2/2001

Contact: Joellen lewtas Jungers

Abstract: Three years of PM2.5 speciated data were collected and chemically analyzed using the IMPROVE protocol at the Beacon Hill site in Seattle. The data were analyzed by the Chemical Mass Balance Version 8 (CMB8) and Positive Matrix Factorization (PMF) source apportionment models. These models were used to identify the major sources of PM2.5, organic and elemental carbon. The major sources of PM2.5 identified by the PMF model are vegetative burning and diesel vehicles. This is generally consistent with the CMB8 analysis which also identified motor vehicles (combined diesel and gasoline) and vegetative burning as major sources. Both models identified secondary sulfate and nitrate as contributing 20-30% of the PM2.5. Using individual organic carbon (OC) and elemental carbon fractions (EC) in the PMF analysis allowed this model to allocate the PM2.5, OC and EC to vegetative burning, diesel vehicles, gasoline vehicles, fuel oil and secondary sources associated with sulfates. A major difference in the results from the two models was the split between vegetative burning and motor vehicles. In the PMF analysis vegetative burning accounted for 35% of the mass, 57% of the OC and 47% of the EC. The CMB8 model attributed 17% of the PM2.5 mass to vegetative burning. Using CMB, motor vehicles accounted for the largest source of PM2.5 (44%). Using the PMF model, two motor vehicle source profiles were identified. One profile clearly corresponded to diesel vehicles (16% PM2.5) and accounted for 36% of the total EC and 19% of the total OC in the aerosol. The second motor vehicle source profile was less dominated by EC and likely represents the gasoline and other non-diesel mobile sources. This motor vehicle source accounted for 6% of PM2.5, 4.5% of the total OC, and 1% of the EC.

This work has been funded by the U S Environmental Protection Agency. It has been subjected to Agency review and approved for publication.

Lewtas, J., Schantz, M.A., and Wise, S.A. Characterization of fine particle associated organic compounds: interlaboratory comparison and development of standard reference materials. Presented at: American Association for Aerosol Research, Portland, OR, October 15-19, 2001.

10/15/2001

Contact: Joellen lewtas Jungers

Abstract: Organic chemicals adsorbed to fine particulate matter (PM) in the ambient air account for a major component of the mass and include source tracers as well as toxic compounds that may contribute to adverse human health effects. The US EPA has established a PM 2.5 research program including aerosol characterization studies at seven sites in the US and additional exposure and health studies at PM Research Centers. A working group of investigators from these and related research programs was established to advance the quality and comparability of data on the organic composition of aerosols. This group is conducting a series of interlaboratory trials using interim reference materials. The initial trial utilized particles sieved to less than 63 microns from a bulk portion of standard reference material (SRM) 1649a, Urban Dust, and an extract of these particles. The original SRM 1649, collected in Washington, DC and issued in 1982, has recently been recertified as 1649a (Wise et al. Polycyclic Aromatic Compounds 13:419-456, 2000). The second trial will utilize PM2.5 samples recently collected in Baltimore. A new bulk PM2.5 sample will be collected from the same site for a final expanded trial and development of a new SRM for contemporary PM2.5. Results from these trials will provide the basis for improved quality assurance measures and methods for characterizing the organic matter associated with PM. The target organic analytes vary among the participants and include: alkanes (including hopanes and cholestanes), alkenes, aromatic and polycyclic aromatic hydrocarbons (PAH), nitrated PAH, sterols, carbonyl compounds (e.g., ketones and aldehydes), acids (alkanoic and resin acids), phenols, methoxy phenols, and sugars. The participating laboratories are not constrained by a specific analytical method, however the analytical methods will be reported as well as detection and quantification limits. This work has been funded by the U S Environmental Protection Agency. It has been subjected to Agency review and approved for publication.

Jan 1, 2001 - Dec 31, 2001

Presented Published

Maykut, N., Lewtas, J., and Larson, T.V. Source apportionment of PM 2.5 and carbon in Seattle using chemical mass balance and positive matrix factorization. Presented at: American Association for Aerosol Research, Portland, OR, October 15-19, 2001.

10/15/2001

Contact: Joellen lewtas Jungers

Abstract: Three years of speciated data (1996-1999) at Seattle's Beacon Hill monitoring site were analyzed by the Chemical Mass Balance Version 8 (CMB8) and Positive Matrix Factorization (PMF) source apportionment models to identify the major sources of PM2.5 and organic carbon. The sampling and analysis data were obtained using the IMPROVE protocol. The sources identified by the PMF model were consistent with those used in previous CMB work. The sources identified by the PMF model are (in descending order of importance): vegetative burning (indoor and outdoor), motor vehicles (gasoline and diesel), secondary sulfate, secondary nitrate, soil, and marine sea salt. The major sources of both PM2.5 and carbon were vegetative burning and motor vehicles. Vegetative burning accounted for 30% of the mass and nearly 67% of the organic carbon (OC). Both models showed that vegetative burning was a major source of PM2.5, however the PMF model identified two sources of vegetative burning; one major source (26% PM2.5) with a profile similar to indoor wood burning and the second minor source (4% PM2.5) is similar to profiles seen for outdoor burning. Both vegetative burning profiles were dominated by OC and contained relatively high concentrations of K. Using CMB, motor vehicles accounted for the largest source of PM2.5 (44%). Using the PMF model, two motor vehicle source profiles were identified. One profile clearly corresponded to diesel vehicles (16% PM2.5) and accounted 40% of the total EC and 15% of the total OC in the aerosol. The second motor vehicle source profile was less dominated by EC and likely represents the gasoline and other non-diesel mobile sources. This motor vehicle source accounted for 11% of PM2.5, 10% of the total OC, and 18% of the EC. Both models generally agree on the contribution to PM2.5 from those aerosols that are primarily inorganic including: secondary sulfate 18-21%, secondary nitrate 4-9%, soil 4-6%, and marine aerosol 5-7% with the variation shown depending on the model. The present study was undertaken to refine the results from previous analyses and to determine the usefulness of applying the PMF model to the Seattle ambient aerosol data. Results from the PMF model not only agree fairly well with previous results but also add insight to the source apportionment results. We found that using both models produces more robust results than using either model alone.

This work has been funded by the U S Environmental Protection Agency. It has been subjected to Agency review and approved for publication.

Lewtas, J., Binkova, B, Myers, S.R., Lenicek, J., Subrt, P., and Sram, R.J. Biomarkers of exposure and metabolic susceptibility to fine particle air pollution. Presented at: BIOMED Seminar, Copenhagen, Denmark, April 26-28, 2001.

4/26/2001

Contact: Joellen lewtas Jungers

Abstract: The influence of metabolic susceptibility (GSTM1 and NAT2 genotypes) on the association between personal air exposures and biomarkers of exposure, dose, and genetic damage were measured for 60 individuals in two regions exposed to ambient air in the Czech Republic. Personal monitors measured exposure to respirable air particles (<1.7 μ m) and the adsorbed polycyclic aromatic hydrocarbons (PAH) for 24 h before collection of blood and urine. Blood samples were analyzed for trace metals, metabolic genotype, DNA adducts, protein adducts, chromosomal aberrations, and sister chromatid exchanges. Urine samples were analyzed for PAH metabolites, cotinine and mutagenic activity. At these environmental exposures to PM1.7 (0.8 - 140 μ g/m³) and PAH (2 - 26 ng/m³), personal exposures to PM1.7 were significantly correlated with personal exposures to carcinogenic PAH ($r = 0.79$, $p < 0.0001$, $n = 60$), total urinary PAH metabolites ($r = 0.48$, $p = 0.0002$, $n = 58$), and two of the trace element levels in blood, selenium ($r = 0.55$, $p < 0.0001$, $n = 60$) and lead ($r = 0.39$, $p = 0.003$, $n = 58$). DNA adduct levels were significantly and linearly correlated with PAH exposure for the nonsmokers ($r = 0.36$, $p < 0.050$, $n = 28$) with either GSTM1 ($r = 0.59$, $p < 0.005$, $n = 21$) or NAT2 rapid ($r = 0.47$, $p < 0.057$, $n = 17$) genotype present. There was a significant increase in correlation between personal PAH exposure and urinary PAH metabolites for NAT2 slow acetylators ($r = 0.58$, $p = 0.001$) compared to NAT2 rapid and GSTM1 genotypes. This suggests that variations in metabolic genotype account for some of the inter-individual variability observed in human biomarker measurements. The urinary PAH metabolites and trace element levels in blood provide potential source tracers for apportioning the sources of human exposure to fine particles. The selenium was associated with high sulfur coal and lead with the leaded gasoline in use during this study. The individual PAH profile is consistent with the sources of PAH in this region. This work has been funded by the U S Environmental Protection Agency. It has been subjected to Agency review and approved for publication.

Jan 1, 2001 - Dec 31, 2001

Presented Published

10/21/2001

Lewtas, J. Characterizing the sources of human exposure to mutagenic and carcinogenic chemicals in airborne fine particles. Presented at: International Conference on Environmental Mutagens, Shizuoka, Japan, October 21-26, 2001.

Contact: Joellen lewtas Jungers

Abstract: Personal and ambient exposures to airborne fine particles, polycyclic aromatic hydrocarbons (PAH), and genotoxic activity has been studied in populations in the US, Japan, China, and the Czech Republic. Personal exposure monitors used to collect fine particles were extracted for analysis of PAH and mutagenic activity. Exposures to tobacco smoke were monitored by measurement of airborne nicotine and/or urinary cotinine. Biomarkers of exposure, dose and susceptibility were measured in blood and urine samples and included metabolic genotype, DNA adducts, PAH metabolites, and urinary mutagenic activity. Stratification by metabolic genotype (GSTM1 and NAT2) decreased the variability in the relationship between personal exposure and biomarkers of exposure and dose. Characterization of the DNA adducts, mutagens, and influence of genotype suggest that nitrated PAH and/or other nitroarenes contribute to airborne exposures. Analysis of PAH profiles for both combustion emission sources and personal PAH exposure profiles led to the identification of benzo[ghi]perylene as a potential source tracer for gasoline engine exhaust and outdoor air. A new multivariate receptor model, recently used to determine the sources of ambient particles, was applied to the analysis of these human exposure and biomarker data. This work has been funded in part by the United States Protection Agency and has been subjected to Agency review and approved for publication.

Jan 1, 2001 - Dec 31, 2001

Presented Published

Norris, G.A., Mukerjee, S., Ozkaynak, H., Smith, L.A., Noble, C.A., Rhodes, C.E., Gonzales, M., and Neas, L. Relationship between fine and ultrafine particle number and VOC species in El Paso, Texas. Presented at: American Association for Aerosol Research, Portland, OR, October 15-19, 2001.

10/15/2001

Contact: Shaibal Mukerjee

Abstract:

Children's exposures to consumer products and environmental contaminants are expected to be different and, in some cases, much higher than adult's exposures. The objectives of our children's exposure research at the National Exposure Research Laboratory are to make use of existing information in developing improved exposure assessment methods and models for children; and to design and conduct research on exposure that will answer questions about age-related differences and will lead to better exposure assessments for children. For this purpose, exposure is defined as the contact of an individual (at visible external boundaries) with a pollutant for specific durations of time. Exposure assessments are developed to characterize "real-life" situations, whereby: a) potentially exposed populations are identified, b) potential pathways of exposure are identified, and c) the magnitude, frequency, duration and time-pattern of contact with a chemical (potential doses) are quantified.

Assessing exposures to consumer products and environmental contaminants in a non-occupational setting poses some significant challenges. Understanding dermal and non-dietary exposures to infants and young children is particularly difficult for several reasons. Infants and young children are experiencing rapid physiological and behavioral development. These developmental stages will impact both a child's susceptibility to toxic effects as well as the potential for exposure. An understanding of physiological and behavioral characteristics as a function of the age and developmental stage of a child is critical for categorizing children and collecting data on their exposures. Children behave very differently than adults. Children's behavior and the way that children interact with their environment may have a profound effect on the magnitude of their chemical exposures. Children crawl, roll, and climb over contaminated surfaces, resulting in higher dermal contact than would be experienced by adults in the same environment. Increased dietary ingestion of contaminants occurs when children handle and eat foods that have come in contact with the floor or other contaminated surfaces. Children's mouthing activities (hand-to-mouth and object-to-mouth) will result in non-dietary ingestion of chemicals if the hands or objects are contaminated. An improved understanding of the behaviors that lead to exposures as well as the inter and intra-individual variability associated with these behaviors is needed.

It is difficult to develop and verify exposure factors for infants and young children. Controlled laboratory studies in which children are intentionally exposed to contaminants are inappropriate. Using adult surrogates for these studies introduces bias, because adults cannot mimic the contact activities of children. Developing an accurate record of an infant's activity patterns also poses a challenge. Direct observation (including videotaping) is considered the most accurate way to record an infant's activities, especially as they relate to dermal exposure. However, this methodology is very labor intensive and costly. Before detailed activity data can be effectively collected and evaluated, knowledge is required on important activities and contact parameters. It is also difficult to monitor children's exposures in the field. Current techniques for measuring dermal exposure are limited in utility. Measures of skin contamination do not reflect changes in dermal loading that occur subsequent to sampling and do not indicate the amount of contamination actually absorbed through the skin. In addition, dermal measurement methods developed for occupational use (where the environment and physical activities may be relatively homogenous) may not be useful for measuring children's residential exposures. There are also significant challenges associated with collecting and interpreting biomarker data (e.g., urine) from children, making it difficult to verify exposure factors and assessment approaches for infants and young children.

Currently, the data on children's exposures and activities are insufficient to adequately assess residential exposures to consumer products and environmental contaminants. To improve this database, several general areas of research are required. Appropriate age/developmental benchmarks for categorizing children in exposure assessments must be identified. To do this, a better understanding is required of the relationship between behavioral and biological development as well as the importance of each in creating critical windows of susceptibility. The activity pattern data for children (especially young children) required to assess exposure by all routes need to be developed. Methods for monitoring children's exposures need to be developed and improved. Finally, population based field studies are needed to monitor for compounds of concern in residential media and for the associated biomarkers in children's blood and urine.

Researchers in government, academia, and industry have begun to address all of these issues. Collaborative efforts among these groups promise to quickly move the state of exposure science forward. As a result, over the next five to ten years, expect to see improved methods and approaches for conducting exposure assessments, development of the databases required to conduct these assessments, and significant reduction in the uncertainty associated with exposure assessments for children. This work has been funded wholly or in part by the United States Environmental Protection Agency. It has been subjected to Agency review and approved for publication.

Jan 1, 2001 - Dec 31, 2001

Presented Published

10/15/2001

Landis, M.S., Stevens, R.K., and Keeler, G.J. Standardized automated and manual methods to speciate mercury: field and laboratory studies. Presented at: 6th International Conference on Mercury as a Global Pollutant, Minamata, Japan, October 15-19, 2001.

Contact: Matthew S. Landis

Abstract: The urban atmosphere contains a large number of air pollutants including mercury. Atmospheric mercury is predominantly present in the elemental form (Hg⁰). However emissions from industrial activities (e.g. incinerators, fossil fuel combustion sources and others) emit other forms of mercury some that are attached to particles and others that are in the vapor phase. Some of these vapor phase species (e.g. HgCl₂) are highly water-soluble. Those Hg species that are water-soluble are called Reactive Gaseous Mercury (RGM). Particulate phase mercury (HgP) and RGM have much shorter half-lives in the atmosphere than Hg⁰ due to their higher removal rates through dry and wet deposition mechanisms and the low reactivity of Hg⁰. For this reason, sensitive areas near sources that emit RGM are likely to become contaminated. Over the past 4 years, many scientists throughout the world, engaged in atmospheric mercury research have been using the newly developed KCl-coated quartz annular denuders to collect and measure RGM. Tekran Inc. manufactures automated instrumentation that incorporates this annular denuder. Recently a manual method to measure RGM and HgP has been developed jointly by the USEPA and the FL DEP. The method uses a uniquely designed manually operated KCL quartz denuders followed by a filter pack with a quartz filter to collect RGM and HgP, respectively. After collection, the denuders are thermally desorbed and the RGM converted to Hg⁰ and measured with a Tekran 2537A CVAFS analyzer, under laboratory conditions. As part of this research, the authors have observed that methods to measure HgP had a significant positive artifact when RGM coexists with HgP. This artifact was eliminated if a KCl coated annular denuder preceded the filter. The authors report for the first time quantitative data documenting the extent of this HgP sampling artifact. As part of this presentation, manual and automated measurements of RGM and HgP from a variety of field studies will be presented. The data to be presented document via statistical analysis the quantifiable ranges of uncertainties for the measurement of Hg⁰, RGM and HgP obtained with the automated and manual instrumentation. This work has been funded wholly or in part by the United States Environmental Protection Agency Office of Research and Development. It has been subjected to peer review and approved for publication.

Landis, M.S., and Stevens, R.K. Preliminary results from the USEPA mercury speciation network and aircraft measurement campaigns. Presented at: 6th International Conference on Mercury as a Global Pollutant, Minamata, Japan, October 15-19, 2001.

10/15/2001

Contact: Matthew S. Landis

Abstract: In 1999, the US EPA National Exposure Research Laboratory (NERL) through a Regional Applied Research Effort initiated a study to evaluate the magnitude of long-range transport of mercury through the marine free troposphere to South Florida via aircraft measurements (200 to 11,500 feet). NERL funded the National Oceanic and Atmospheric Administration Air Resources Laboratory (ARL) to provide a DeHavilland Twin Otter aircraft and personnel to collaborate with the collection of aerosol and trace gas measurements. A heated Teflon-coated aluminum inlet system with a quazi-isokinetic decelerator jet tip was installed in the aircraft to direct an air stream into a manifold where elemental gas phase mercury (Hg⁰), reactive gaseous mercury (Hg²⁺), particulate phase mercury, and trace element aerosols were collected by NERL. In addition, ARL collected real time measurements of ozone, carbon monoxide, sulfur dioxide, nitrogen oxides (NO, NO_x, NO_y), and condensation nuclei. Two separate study periods of 50 flight hours were planned. The first study period was conducted from January 18, through February 1, 2000 when the tropospheric winds typically transport air to South Florida from the Gulf of Mexico and the North American continent. Flights for the second study period were conducted from June 3 through June 26, 2000 when South Florida is predominantly influenced from easterly marine transport. Preliminary results from the flights indicate that mercury concentrations were significantly higher within air masses with continental influence. The Hg⁰ concentrations were observed to be higher below 5000 feet (2.3 ± 0.4 ng m⁻³) than above 5000 feet (1.5 ± 0.4 ng m⁻³). Conversely, the concentrations of Hg²⁺ were typically higher above 5000 feet (49 ± 28 pg m⁻³) than below (12 ± 7 pg m⁻³). Meteorological modeling and chemical tracer results will be presented. This work has been funded wholly or in part by the United States Environmental Protection Agency Office of Research and Development. It has been subjected to peer review and approved for publication.

Jan 1, 2001 - Dec 31, 2001

Presented Published

Landis, M.S., Stevens, R.K., Luke, W., and Keeler, G.J. Investigating the influence of long range transport on mercury deposition in south Florida. Presented at: 6th International Conference on Mercury as a Global Pollutant, Minamata, Japan, October 15-19, 2001.

10/15/2001

Contact: Matthew S. Landis

Abstract: In 1999, the US EPA National Exposure Research Laboratory (NERL) through a Regional Applied Research Effort initiated a study to evaluate the magnitude of long-range transport of mercury through the marine free troposphere to South Florida via aircraft measurements (200 to 11,500 feet). NERL funded the National Oceanic and Atmospheric Administration Air Resources Laboratory (ARL) to provide a DeHavilland Twin Otter aircraft and personnel to collaborate with the collection of aerosol and trace gas measurements. A heated Teflon-coated aluminum inlet system with a quasi-isokinetic decelerator jet tip was installed in the aircraft to direct an air stream into a manifold where elemental gas phase mercury (Hg⁰), reactive gaseous mercury (Hg²⁺), particulate phase mercury, and trace element aerosols were collected by NERL. In addition, ARL collected real time measurements of ozone, carbon monoxide, sulfur dioxide, nitrogen oxides (NO, NO_x, NO_y), and condensation nuclei. Two separate study periods of 50 flight hours were planned. The first study period was conducted from January 18, through February 1, 2000 when the tropospheric winds typically transport air to South Florida from the Gulf of Mexico and the North American continent. Flights for the second study period were conducted from June 3 through June 26, 2000 when South Florida is predominantly influenced from easterly marine transport. Preliminary results from the flights indicate that mercury concentrations were significantly higher within air masses with continental influence. The Hg⁰ concentrations were observed to be higher below 5000 feet (2.3 ± 0.4 ng m⁻³) than above 5000 feet (1.5 ± 0.4 ng m⁻³). Conversely, the concentrations of Hg²⁺ were typically higher above 5000 feet (49 ± 28 pg m⁻³) than below (12 ± 7 pg m⁻³). Meteorological modeling and chemical tracer results will be presented. This work has been funded wholly or in part by the United States Environmental Protection Agency Office of Research and Development. It has been subjected to peer review and approved for publication.

Noble, C.A., Rodes, C.E., Lawless, P.A., Natarajan, S., Myers, E.A., Mukerjee, S., Ozkaynak, H., Gonzales, M., and Neas, L. Correlation of fine and ultrafine particulate matter with meteorological conditions and criteria pollutants in El Paso, Texas. Presented at: American Association for Aerosol Research, Portland, OR, October 15-19, 2001.

10/15/2001

Contact: Shaibal Mukerjee

Abstract: Because the harmful health effects of airborne particulate matter (PM) are not well understood, various researchers are investigating ambient PM in order to assess its hazardous components. Current hypotheses acknowledge that PM related morbidity and mortality may be a result of both physical and chemical properties of the aerosol. Among potential PM indicators are ultrafine particles (those smaller than approximately 0.1 µm). Previous epidemiological and toxicological research has suggested that there is a correlation between ultrafine particle number concentration and human health end points. To investigate ambient ultrafine PM, continuous measurements of aerosol size distributions were made in El Paso, Texas, a city along the US/Mexico border. Sampling was conducted over a twenty-one day period in winter 1999. Size distribution measurements were performed at two urban locations using two coupled pairs of the scanning mobility particle sizer (SMPS) and the aerodynamic particle sizer (APS). Complementary measurements also were performed for gas phase pollutants and meteorological conditions. The data were analyzed as hourly averages. Throughout the study, the mean ultrafine particle number concentration in El Paso was 14,400 particles per cubic centimeter. Most pollutants were found to vary on diurnal cycles and to follow one of two different trends, either vehicular traffic schedules or sunlight intensity. Wind direction was found to have a significant influence not only on pollutant concentrations, but also on the correlation between pollutants. With southerly winds, CO, NO, and NO₂ concentrations were 25-140% greater than when the wind was coming from the north. Likewise, ultrafine particle concentrations were approximately 100% greater for southerly than for northerly winds. This is an abstract of a proposed presentation and does not necessarily reflect EPA policy. Mention of trade names or commercial products does not constitute an endorsement or recommendation for use.

Jan 1, 2001 - Dec 31, 2001

Presented Published

Lewis, C.W., Klouda, G.A., and Ellenson, W.D. Radiocarbon measurements on PM 2.5 ambient aerosol from Nashville, TN. Presented at: American Association for Aerosol Research Annual Meeting, Portland, OR, October 15-19, 2001.

10/15/2001

Contact: Charles W. Lewis

Abstract: Radiocarbon (Carbon-14) measurements provide an estimate of the fraction of carbon in a sample that is biogenic. The methodology has been extensively used in past wintertime studies to quantify the contribution of wood smoke to ambient aerosol. In summertime such measurements can provide an upper limit on the contribution of biogenic volatile organic compounds, through gas-to-particle conversion, to ambient PM-2.5 aerosol. Since this component of PM-2.5 is virtually uncontrollable, its quantification is important in the formulation of realistic overall control goals for summertime PM-2.5. Radiocarbon results will be reported for samples collected in Nashville, Tennessee during the summertime 1999 Southern Oxidant Study. This work has been funded wholly or in part by the United States Environmental Protection Agency under Interagency Agreement No. 13937923 to the National Institute of Standards and Technology, and Contract No. 68-D5-0049 to ManTech Environmental Technology, Inc. It has been subjected to Agency review and approved for publication.

BOOK

Solomon, P.A., Norris, G.A., Landis, M.S., and Tolocka, M.P. "Chemical analysis methods for atmospheric aerosol components." In: Aerosol Measurements, Chapter 11 New York, NY: Van Nostrand Reinhold 2001.

1/8/2001

Contact: Paul A. Solomon

Abstract: This chapter surveys the analytical techniques used to determine the concentrations of aerosol mass and its chemical components. The techniques surveyed include mass, major ions (sulfate, nitrate, ammonium), organic carbon, elemental carbon, and trace elements. As reported in the literature, there are wide variations in the chemical composition of the aerosol and their concentrations, thus, requiring application of several analytical methods to obtain valid data. Over the last decade, determination of organic aerosol species in ambient particulate matter has become feasible. Availability of this type of detailed organic aerosol data have greatly enhanced the ability of receptor models to identify sources (Schauer et al. 1996; Schauer and Cass 2000). Thus, analytical methods to determine organic aerosol species are described in this chapter. Finally, semi-continuous species-specific methods, are rapidly emerging that could eliminate the need to collect aerosols on filters with retrospective chemical analysis in the laboratory. These methods are becoming available for sulfate, nitrate, other anions and cation species, OC, EC, and trace elements. These methods are mentioned briefly at the end of this chapter. The analysis method is only one aspect involved in determining the concentration of species in atmospheric particulate matter after collection of the sample on a filter or other substrate. Other issues include sample storage, where applicable, sample extraction from the filter, and quality control and quality assurance. Sample storage includes stabilizing the collected sample from the end of sampling through sample analysis. It also may include long-term storage to allow for reanalysis of the filter later. Finally, precision and accuracy of the measurements are needed to define uncertainty in data. These issues also will be briefly mentioned in this chapter.

Jan 1, 2001 - Dec 31, 2001

Presented Published

Mishra, N.N., Pedersen, J.A., and Rogers, K.R. "Highly sensitive assay for anticholinesterase compounds using 96 well plate format." In: Chemicals in the Environment: Fate, Impacts, and Remediation, Chapter 16 M. L. Phillips (Ed.), Washington, DC: American Chemical Society 2001, 289-305.

12/31/2001

Contact: Kim R. Rogers

Abstract: The rapid and sensitive detection of organophosphate insecticides using a 96 well plate format is reported. Several features of this assay make it attractive for development as a laboratory-based or field screening assay. Acetylcholinesterase (AChE) was stabilized in a gelatin film. The remarkable properties of the dry immobilized AChE preparation include its stability to prolonged storage at room temperature as well as its stability to short term elevated temperatures (60 C). The enzyme could be maintained in dry gel form for 365 days at room temperature without substantial loss of activity. The absorbance assay used to measure enzyme activity was evaluated using several solvent systems including water, phosphate buffer, hexane, methanol and ethanol. The AChE activity in hexane was similar to that in the aqueous systems, however, the more polar organic solvents such as methanol and ethanol decreased the enzyme activity by about 90%. The microwell assay includes a procedure to oxidize less potent P=S organophosphate compounds to their more inhibitory oxon forms. Log-logit or four parameter equations were applied to the data to determine IC50 (molar concentration yielding 50% inhibition) values. The use of this assay to analyze field samples contaminated with mixtures of organophosphates is also reported. The U.S. Environmental Protection Agency (EPA), through its Office of Research and Development (ORD), funded this research and approved this manuscript for publication. Mention of trade names or commercial products does not constitute endorsement or recommendation of these products by the EPA.

JOURNAL

Seila, R.L., Main, H.H., Arriaga, J.L., Martinez, G., and Ramadan, A.B. Atmospheric volatile organic compound measurements during the 1996 Paso del Norte ozone study. Science of the Total Environment 276 (1-3):153-169 (2001). EPA/600/J-01/250.

9/4/2001

Contact: Robert L. Seila

Abstract: Ambient air VOC samples were collected at surface air quality monitoring sites, near sources of interest, and aloft on the US (El Paso) and Mexican (Ciudad Juarez) side of the border during a six-week period of the 1996 Paso del Norte Ozone Study. Samples were collected at five sites, three on the US side and two on the Mexican side, during nine intensive operation days when high ozone levels were forecast for the area. Six other sites were sampled to characterize up-wind, down-wind and other emission sources. Samples for determining source profiles were collected for rush hour traffic, propane-powered bus exhaust, automobile paint shop emissions, propane fuels, and industrial manufacturing in Cd. Juarez and a refinery in El Paso. Most samples were collected in electro-polished stainless steel canisters for determination of C2 to C10+ hydrocarbons by GC-FID. Carbonyl samples were collected on DNPH impregnated cartridges at three surface sites during aircraft flights and analyzed by HPLC. This paper presents the spatial and temporal characteristics of VOC species concentrations and compositions to examine the differences and similarities of the various locations and time periods. Overall surface, total non-methane hydrocarbon values ranged from 0.1 to 3.4 ppmC with the highest concentrations being recorded in the morning and evening at five vehicle-dominated sites, three in Cd. Juarez and two in El Paso. Toluene in El Paso samples and propane, which is used as a cooking and transportation fuel in Cd. Juarez, were the most abundant hydrocarbons. The most abundant carbonyls were acetaldehyde, acetone and formaldehyde. The information in this document has been funded wholly or in part by the United States Environmental Protection Agency under Contract 68-D3-0030 to Science Applications International Corporation. It has been subjected to agency review and approved for publication. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

Jan 1, 2001 - Dec 31, 2001

Presented Published

5/1/2001

Buck, R.J., Ozkaynak, H., Xue, J., Zartarian, V., and Hammerstrom, K. Modeled estimates of chlorpyrifos exposure and dose for the Minnesota and Arizona NHEXAS populations. *Journal of Exposure Analysis and Environmental Epidemiology* 11 (3):253-268 (2001). EPA/600/J-02/228.

Contact: Haluk Ozkaynak

Abstract: This paper presents a probabilistic, multimedia, multipathway exposure model and assessment for chlorpyrifos developed as part of the National Human Exposure Assessment Survey (NHEXAS). The model was constructed using available information prior to completion of the NHEXAS study. It simulates the distribution of daily aggregate and pathway-specific chlorpyrifos absorbed dose in the general population of the State of Arizona (AZ) and in children aged 3 to 12 years residing in Minneapolis-St. Paul, Minnesota (MSP). Pathways included were inhalation of indoor and outdoor air, dietary ingestion, non-dietary ingestion of dust and soil, and dermal contact with dust and soil. Probability distributions for model input parameters were derived from the available literature, and input values were chosen to represent chlorpyrifos concentrations and demographics in AZ and MSP to the extent possible. When the NHEXAS AZ and MSP data become available, they can be compared to the distributions derived in this and other prototype modeling assessments to test the adequacy of this pre-NHEXAS model assessment. Although pathway-specific absorbed dose estimates differed between AZ and MSP due to differences in model inputs between simulated adults and children, the aggregate model results and general findings for simulated AZ and MSP populations were similar. The major route of chlorpyrifos intake was food ingestion, followed by indoor air inhalation. Two-stage Monte Carlo simulation was used to derive estimates of both inter-individual variability and uncertainty in the estimated distributions. The variability in the model results reflects the difference in activity patterns, exposure factors, and concentrations contacted by individuals during their daily activities. Based on the coefficient of variation, indoor air inhalation and dust ingestion were most variable relative to the mean, primarily because of variability in concentrations due to use or no-use of pesticides. Uncertainty analyses indicated a factor of 10-30 for uncertainty of model predictions of 10th, 50th, and 90th percentiles. The greatest source of uncertainty in the model stems from the definition of no household pesticide use as no use in the past year. Because chlorpyrifos persists in the residential environment for longer than a year, the modeled estimates are likely to be low. More information on pesticide usage and environmental concentrations measured at different post-application times is needed to refine and evaluate this and other pesticide exposure models. The U.S. Environmental Protection Agency through its Office of Research and Development funded and collaborated in the research described here under NHEXAS Cooperative Agreement Number CR822038-1 to Harvard University. It has been subjected to Agency review and approved for publication. Mention of trade names or commercial products does not constitute an endorsement or recommendation for use.

Jan 1, 2001 - Dec 31, 2001

Presented Published

Burke, J.M., Zufall, M.J., and Ozkaynak, H. A population exposure model for particulate matter: case study results for PM 2.5 in Philadelphia, PA. *Journal of Exposure Analysis and Environmental Epidemiology* 11 (6):470-489 (2001). EPA/600/J-02/125.

12/1/2001

Contact: Janet M. Burke

Abstract: A population exposure model for particulate matter (PM), called the Stochastic Human Exposure and Dose Simulation (SHEDS-PM) model, has been developed and applied in a case study of daily PM_{2.5} exposures for the population living in Philadelphia, PA. SHEDS-PM is a probabilistic model that estimates the population distribution of total PM exposures by randomly sampling from various input distributions. A mass-balance equation is used to calculate indoor PM concentrations for the residential microenvironment from ambient outdoor PM concentrations and physical factor data (e.g., air exchange, penetration, deposition), as well as emission strengths for indoor PM sources (e.g., smoking, cooking). PM concentrations in non-residential microenvironments are calculated using equations developed from regression analysis of available indoor and outdoor measurement data for vehicles, offices, schools, stores and restaurants/bars. Additional model inputs include demographic data for the population being modeled and human activity pattern data from EPA's Consolidated Human Activity Database (CHAD). Model outputs include distributions of daily total PM exposures in various microenvironments (indoors, in vehicles, outdoors), and the contribution from PM of ambient origin to daily total PM exposures in these microenvironments. SHEDS-PM has been applied to the population of Philadelphia using spatially and temporally interpolated ambient PM_{2.5} measurements from 1992-93 and 1990 U.S. Census data for each census tract in Philadelphia. The resulting distributions showed substantial variability in daily total PM_{2.5} exposures for the population of Philadelphia (median=20 $\mu\text{g}/\text{m}^3$; 90th percentile=59 $\mu\text{g}/\text{m}^3$). Variability in human activities, and the presence of indoor residential sources in particular, contributed to the observed variability in total PM_{2.5} exposures. The uncertainty in the estimated population distribution for total PM_{2.5} exposures was highest at the upper end of the distribution and revealed the importance of including estimates of input uncertainty in population exposure models. The distributions of daily microenvironmental PM_{2.5} exposures (exposures due to time spent in various microenvironments) indicated that indoor residential PM_{2.5} exposures (median=13 $\mu\text{g}/\text{m}^3$) had the greatest influence on total PM_{2.5} exposures compared to the other microenvironments. The distribution of daily exposures to PM_{2.5} of ambient origin was less variable across the population than the distribution of daily total PM_{2.5} exposures (median=7 $\mu\text{g}/\text{m}^3$; 90th percentile=18 $\mu\text{g}/\text{m}^3$) and similar to the distribution of ambient outdoor PM_{2.5} concentrations. This result suggests that human activity patterns did not have as strong an influence on ambient PM_{2.5} exposures as was observed for exposure to other PM_{2.5} sources. For most of the simulated population, exposure to PM_{2.5} of ambient origin contributed a significant percent of the daily total PM_{2.5} exposures (median=37.5%), especially for the segment of the population without exposure to environmental tobacco smoke in the residence (median=46.4%). Development of the SHEDS-PM model using the Philadelphia PM_{2.5} case study also provided useful insights into the limitations of currently available data for use in population exposure models. In addition, data needs for improving inputs to the SHEDS-PM model, reducing uncertainty and further refinement of the model structure were identified.

Edney, E.O., Driscoll, D.J., Weathers, W.S., Kleindienst, T.E., Conner, T.S., McIver, C.D., and Li, W. Formation of polyketones in irradiated toluene/propylene/NOx/air mixtures. *Aerosol Science and Technology* 35 (6):998-1008 (2001). EPA/600/J-02/215.

12/1/2001

Contact: Edward O. Edney

Abstract: A laboratory study was carried out to investigate the formation of polyketones in secondary organic aerosol from photooxidation of the aromatic hydrocarbon toluene, a major constituent of automobile exhaust. The laboratory experiments consisted of irradiating toluene/propylene/NOx/air mixtures in a smog chamber operated in the dynamic mode and collecting submicron secondary organic aerosol samples on ZefluorTM filters and on stainless steel disks in a low pressure cascade impactor. Carbonyl oxidation products in methanol extracts of the filters were derivatized using O-(2,3,4,5,6-pentafluorobenzyl)-hydroxylamine and the oxime derivatives were detected with a positive chemical ionization gas chromatography ion trap mass spectroscopy (GC-ITMS) system. Infrared spectra of the cascade impactor samples were used to determine the chemical functional group concentrations of the aerosol. The results of the GC-ITMS and infrared spectral analyses were consistent with the formation of multi-functional oxygenates, including hydroxy diones as well as triones, tetraones and pentaones. The U.S. Environmental Protection Agency through its Office of Research and Development funded and collaborated in the research described here under Contract 68-D5-0049 to man Tech Environmental Technology, Inc. It has been subject to Agency review and approved for publication. Mention of trade names or commercial products does not constitute an endorsement or recommendation for use.

Jan 1, 2001 - Dec 31, 2001

Presented Published

Noble, C., Vanderpool, R.W., Peters, T.M., McElroy, F.F., Gemmill, D.B., and Wiener, R.W. Federal reference and equivalent methods for measuring fine particulate matter. *Aerosol Science and Technology* 34 (5):457-464 (2001). EPA/600/J-02/214.

5/1/2001

Contact: David B. Gemmill

Abstract:

In the national ambient air quality standards specified by the U.S. Environmental Protection Agency in the Code of Federal Regulations, new standards were established for particulate matter on July 18, 1997. The new particulate matter standards specify mass concentration as the indicator for fine particulate matter (aerodynamic diameter of 2.5 μm or less). Ambient measurements for the new particulate standard must be performed by a new federal reference method as specified in the Code of Federal Regulations or by an alternative measurement method that has been designated by the Environmental Protection Agency as an equivalent method. The new particulate reference method is a 24 h integrated sample collected from the ambient air and analyzed gravimetrically. The reference method is explicitly specified using a combination of design-and performance-based criteria. Additional requirements listed in the Code of Federal Regulations address conditioning, handling, and weighing of the sample filter, which are performed manually. For alternative measurement techniques that do not meet the qualifications of the reference method, the Environmental Protection Agency defines three classes of candidate PM_{2.5} equivalent methods based on the measurement technique used and its degree of similarity to the reference method specifications. The U.S. Environmental Protection Agency through its Office of Research and Development funded and managed the search described here under contract 68-D5-0040 to Research Triangle Institute. It has been subjected to Agency review and approved for publication. Mention of trade names or commercial products does not constitute an endorsement or recommendation for use.

Mamane, Y., Willis, R.D., and Conner, T.L. Evaluation of computer-controlled scanning electron microscopy applied to an ambient urban aerosol sample. *Aerosol Science and Technology* 34 (1):97-107 (2001). EPA/600/J-01/081.

3/27/2001

Contact: Teri L. Conner

Abstract:

Concerns about the environmental and public health effects of particulate matter (PM) have stimulated interest in analytical techniques capable of measuring the size and chemical composition of individual aerosol particles. Computer-controlled scanning electron microscopy (CCSEM) coupled with energy-dispersive X-ray analysis (EDX) allows automated analysis of particle size, chemistry, and particle classification. In combination with manual SEM and bulk analytical techniques such as X-ray fluorescence, CCSEM can be a valuable tool for characterizing individual ambient particles and determining sources of ambient PM. The goal of this study was to examine several issues related to the quality and validity of CCSEM data. These included the stability of unattended CCSEM for multihour runs, the number of particles that must be analyzed in order to yield representative results, and errors associated with CCSEM. CCSEM was applied to the analysis of a 24 h ambient particle sample collected in Baltimore, MD. The coarse-fraction sample (PM_{10-2.5}) was collected with a dichotomous sampler on a polycarbonate filter. A total of 2819 particles in 78 randomly selected fields of view were analyzed by CCSEM during an unattended 8 h run. Particle diameter, aspect ratio, particle location, X-ray counts for 20 elements, and digital images of each particle and its field of view were stored. The average number of particles per field (N/F), average particle diameter (Dave), average mass loading per field (Mave), and average particle composition were calculated for subsets of the data and compared against results for the full data set in order to assess the stability of the CCSEM analysis over time and the number of particles needed to obtain representative results. These comparisons demonstrated excellent stability of CCSEM over the 8 h run. Physical properties (represented by N/F, Dave, and Mave) of the sample were well characterized by analyzing approximately 360 particles. Chemical properties of the sample (average elemental composition and major chemical class abundances) converged to within a few percent of their final values after analyzing about 1000 particles. However, for many purposes several hundred particles may provide adequate characterization. Convergence of minor class abundances was limited by statistical fluctuations as the number of particles populating a class became very small. Manual review of the CCSEM data identified errors associated with CCSEM due to missed particles, overlapping particles, contrast artifacts, sizing errors, and heterogeneous particles. Most errors could be corrected or eliminated during manual off-line review of the data or avoided by maintaining a proper particle loading on the filter. The U.S. Environmental Protection Agency through its Office of Research and Development funded the research described here under contract 68-D5-0049 to ManTech Environmental Technology, Inc.; and under purchase order 9D-0710-NTTX for Dr. Yaacov Mamane. It has been subjected to agency review and approved for publication. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

Jan 1, 2001 - Dec 31, 2001

Presented Published

Tolocka, M.P., Tseng, P.T., and Wiener, R.W. Optimization of the wash-off method for measuring aerosol concentrations. *Aerosol Science and Technology* 34 (5):416-421 (2001). EPA/600/J-02/122.

5/1/2001

Contact: Roy L. Bennett

Abstract: Using the fluorescence-washing technique, oleic acid particles tagged with uranine were extracted and analyzed fluorometrically. The possible sources of errors in the technique were evaluated in this study. First, the sensitivity of uranine fluorescence in different solutions was compared. The results indicated that uranine in distilled water with pH 10 buffer and in sodium hydroxide have high sensitivity. Second, the interference of oleic acid with uranine quantification in a variety of media was investigated. It was found that there is no interference from oleic acid in distilled water and sodium hydroxide solutions under our operating conditions. However, oleic acid did significantly quench the uranine fluorescence signal in ethanol. Third, the ability of different solutions to extract uranine from glass fiber and TeflonO filters was tested. The results indicated that distilled water and sodium hydroxide solutions have the highest extraction ability of the media evaluated. Based on the results above, distilled water, 0.001N sodium hydroxide, and 0.01 N sodium hydroxide solutions were the optimal washing solutions in the fluorescence-washing technique. It was also found that, for inlet washes, distilled water would not be reactive and have high extraction efficiency.

Tolocka, M.P., Solomon, P.A., Mitchell, W.J., Norris, G.A., Gemmill, D.B., Wiener, R.W., Vanderpool, R.W., Homolya, J.P., and Rice, J. East vs. west in the US: chemical characteristics of PM 2.5 during the winter of 1999. *Aerosol Science and Technology* 34 (1):88-96 (2001). EPA/600/J-01/275.

9/5/2001

Contact: Roy L. Bennett

Abstract: The chemical composition of PM2.5 was investigated at four sites (Rubidoux, CA, Phoenix, AZ, Philadelphia, PA, and RTP, NC) in January and February of 1999. Three samplers were used to determine both the overall mass and the chemical composition of the aerosol. Teflon filters were weighed for total mass. Ions were analyzed using ion chromatography. Elements were determined using X-Ray fluorescence. Organic and elemental carbon were measured using a thermo-optical method. At all of the sites, reconstructed mass was observed to be greater than or equal to the measured mass. Good ionic balance was found for ammonium, nitrate and sulfate at each of the sites. Overall, the chemical composition of the aerosol for each site was in good agreement with the expected composition based upon previous studies, with the exception of relatively high nitrate contribution to the total mass at Philadelphia. Good agreement was found between the predicted amount of sulfate by XRF analysis of sulfur and the sulfate measured by ion chromatography. As expected, sulfate was a more important contributor to the total mass at the East Coast sites. Nitrate contributed more to the total mass at the west coast sites and was an important factor in the highest observed mass concentration at Rubidoux,. Teflon filters appear to lose nitrate to a greater extent than heat-treated quartz fiber filters. Organic carbon was also found to be the largest part of the aerosol mass on minimum days for all sites and a significant portion of the mass on other days with 25-50% of the total mass at all of the sites. At three of the sites, OC collected on denuded filters was less than that found on non-denuded samples, indicating an absorptive artifact on the quartz fiber filters. It was also found that the crustal component to PM2.5 was highest at Phoenix. PM2.5 was also found to contribute significantly to the PM10 particle mass at all the sites. This work has been funded wholly or in part by the United States Environmental Protection Agency. Portions of the work were performed under contract no. 68-D5-0040 by Research Triangle Institute. It has been subjected to Agency review and approved for publication. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

Jan 1, 2001 - Dec 31, 2001

Presented Published

Vanderpool, R.W., Peters, T., Natarajan, S., Tolocka, M.P., Gemmill, D.B., and Wiener, R.W. Sensitivity analysis of the USEPA WINS PM 2.5 separator. *Aerosol Science and Technology* 34 (5):465-476 (2001). EPA/600/J-01/264.

9/4/2001

Contact: Curtis M. Morris

Abstract: Factors affecting the performance of the US EPA WINS PM_{2.5} separator have been systematically evaluated. In conjunction with the separator's laboratory calibrated penetration curve, analysis of the governing equation that describes conventional impactor performance was used to predict changes in cutpoint as a function of impactor dimensions, flow rate, uncertainties in ambient temperature and pressure measurement, and the temperature and pressure of the sampled air volume. By integrating the resulting performance curves with three idealized ambient aerosol size distributions, the effect of these parameters on measured PM_{2.5} concentration was predicted. Results showed that allowable variations in impactor jet width, flow rate, diffusion oil volumes, and ambient temperature and pressure measurement result in relatively minimal PM_{2.5} mass concentration measurement biases. Loading of the WINS well with previously collected particles slightly reduces the separator's cutpoint and thus slightly reduces expected PM_{2.5} mass concentrations. Variations in ambient pressure produce negligible changes in the performance of the WINS. While not causing a true measurement bias as defined by the regulations, low ambient temperatures naturally affect the airstream's properties and inherently shifts the WINS' cutpoint to slightly lower values. Laboratory-induced crystallization of the DOW 704 diffusion oil produced no appreciable changes in either the position or shape of the WINS separation curve. This work was conducted by Research Triangle Institute with support provided by the U.S. Environmental Protection Agency through contract no. 68-D5-0040. It has been reviewed in accordance with the Agency's peer and administrative review policies and approved for presentation and publication. Mention of trade names or commercial products does not constitute endorsement or recommendation by RTI or the Agency.

Willis, R.D., Ellenson, W.D., and Conner, T.L. Monitoring and source apportionment of particulate matter near a large phosphorus production facility. *Journal of the Air & Waste Management Association* 51 (8):1142-1166 (2001). EPA/600/J-01/270.

8/31/2001

Contact: Teri L. Conner

Abstract: A source apportionment study was conducted to identify sources within a large elemental phosphorus plant that contribute to exceedances of the National Ambient Air Quality Standard for 24-h PM₁₀. Ambient data were collected at three monitoring sites from October 1996 through July 1999 and included the following: 24-h PM₁₀ mass, 24-h PM_{2.5} and PM_{10-2.5} mass and chemistry, continuous PM₁₀ and PM_{2.5} mass, continuous meteorological data, and wind-direction-resolved PM_{2.5} and PM₁₀ mass and chemistry. Ambient-based receptor modeling and wind-directional analysis were employed to help identify major sources or source locations and source contributions. Fine-fraction phosphate was the dominant species observed during PM₁₀ exceedances, though in general, resuspended coarse dusts from raw and processed materials at the plant were also needed to create an exceedance. Major sources that were identified included the calciners, the CO flares, process-related dust, and electric-arc furnace operations. The U.S. Environmental Protection Agency through its Office of Research and Development partially funded and managed the research described here under Contracts 68-D5-0049 and 68-D-00-206 to ManTech Environmental Technology, Inc. It has been subject to Agency review and approved for publication. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

Jan 1, 2001 - Dec 31, 2001

Presented Published

Vanderpool, R.W., Peters, T., Natarajan, S., Gemmill, D.B., and Wiener, R.W. Evaluation of the loading characteristics of the EPA WINS PM 2.5 separator. *Aerosol Science and Technology* 34 (5):444-456 (2001). EPA/600/J-01/271.

9/4/2001

Contact: Curtis M. Morris

Abstract: The loading characteristics of the USEPA WINS (Well Impactor Ninety Six) PM_{2.5} separator was an important design consideration during the separator's development. In recognition that all inertial separators eventually overload, the loading surface of the WINS was designed to be easily accessible, replaceable, and cleanable. Prior to promulgation of the method, the loading capacity of the WINS separator was evaluated by measuring its performance after repeated loading with laboratory-generated, high concentration, coarse-mode aerosol. For this purpose, a low flow rate loading wind tunnel was designed and constructed to artificially create coarse mode aerosols composed of Arizona Test Dust. This controlled test atmosphere was sampled by the PM_{2.5} reference method sampling train, as specified in 40 CFR Part 50, Appendix L, at total aerosol mass concentrations averaging 332 µg/m³ for three 24-hour periods. The particle size fractionation characteristics of the WINS was evaluated in the laboratory after each 24-hour sampling event. These performance curves were integrated with three idealized ambient distributions to yield estimates of bias in measured mass concentration with respect to a clean WINS. Test results served as the basis for establishing the required cleaning frequency of the sampler during field use. Following the method's promulgation, characterization of the WINS performance under conditions of actual field use at five U.S. cities showed that a maximum mass concentration bias of -2.1% was estimated for 13 wells after the 5-day sampling period. Overall study results supported the current regulation (USEPA, 1998) that WINS wells be replaced after every 5 days of 24-hour operation. This work was conducted by Research Triangle Institute with support provided by the U.S. Environmental Protection Agency through contract no. 68-D5-0040. It has been reviewed in accordance with the Agency's peer and administrative review policies and approved for presentation and publication. Mention of trade names or commercial products does not constitute endorsement or recommendation by RTI or the Agency.

Peters, T., Vanderpool, R.W., and Wiener, R.W. Design and calibration of the EPA PM 2.5 well impactor ninety-six (WINS). *Aerosol Science and Technology* 34 (5):389-397 (2001). EPA/600/J-01/277.

5/1/2001

Contact: Elizabeth T. Hunike

Abstract: The EPA well-type impactor ninety-six (WINS) was designed and calibrated to serve as a particle size separation device for the EPA reference method sampler for particulate matter under 2.5 µm aerodynamic diameter. The WINS was designed to operate downstream of a PM₁₀ inlet at a volumetric flowrate of 16.7 Lpm. For design simplicity and ease of construction, fractionation of the aerosol in the WINS is provided by a single-stage, single-jet, round-hole impactor. Particles greater than 2.5 µm (aerodynamic diameter) have sufficient inertia to be impacted upon a circular 37 mm diameter glass fiber filter immersed in 1 mL of a low volatility oil. The relatively large amount of oil is intended to minimize substrate overloading and subsequent particle bounce experienced by some conventional impactors and to represent an easily field dispensable quantity of defined tolerance. The novel geometry of the impaction reservoir (or well) is designed to capture any reentrained material from the impaction surface and to prevent loss of oil should the unit be inadvertently turned over or on its side. The penetration curve of the final WINS design has a 50 percent cutpoint diameter equal to 2.48 µm and a geometric standard deviation of 1.18. During development, several nozzle designs and well geometries were evaluated to optimize the performance of the WINS. Additionally, two candidate oils (Neovac and Dow Corning 704 diffusion pump oils) and three types of filters (glass fiber filters, drain discs, and polycarbonate membrane filters) were evaluated for use as impaction substrates in the WINS. The performance of the WINS was similar for the two oils in combination with a glass fiber filter and a drain disc; however, a polycarbonate filter demonstrated elevated penetration values. Based on these tests, a Gelman Type A/E glass fiber filter immersed in Dow Corning 704 diffusion pump oil was selected as the best impaction substrate. Further testing showed that the penetration curve was essentially the same when operated with quantities of oil ranging from 0.75 to 3 mL.

Jan 1, 2001 - Dec 31, 2001

Presented Published

Conner, T.L., Norris, G.A., Landis, M.S., and Williams, R.W. Individual particle analysis of indoor, outdoor, and community samples from the 1998 Baltimore particulate matter study. Atmospheric Environment 35 (23):3935-3946 (2001). EPA/600/J-01/269.

8/31/2001

Contact: Teri L. Conner

Abstract: The United States Environmental Protection Agency (U.S. EPA) recently conducted the 1998 Baltimore Particulate Matter (PM) Epidemiology-Exposure Study of the Elderly. The primary goal of that study was to establish the relationship between outdoor PM concentrations and actual human PM exposures within a susceptible (elderly) sub-population. Personal, indoor, and outdoor sampling of particulate matter was conducted at a retirement center in the Towson area of northern Baltimore County. Concurrent sampling was conducted at a central community site. The main objective of this work was to use computer-controlled scanning electron microscopy with individual-particle X-ray analysis (CCSEM) to measure the chemical and physical characteristics of geological and trace element particles collected at the various sampling locations in and around the retirement facility. The CCSEM results show that the relative abundances of some geological and trace element particle classes identified at the outdoor and community locations differ from each other and from the indoor location. Particle images acquired during the computer-controlled analyses played a key role in the identification of certain particle types. Review of these images was particularly useful in distinguishing spherical particles (usually indicative of combustion) from non-spherical particles of similar chemical composition. Pollens and spores were also identified through a manual review of the particle images. This work has been funded wholly or in part by the U.S. Environmental Protection Agency (1997) under contract #68-D5-0040 to the Research Triangle Institute and under contract #68-D5-0049 to ManTech Environmental Technology, Inc. It has been subjected to Agency review and approved for publication. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

McClenny, W.A., Colon, M., and Oliver, K.D. Ozone reaction with n-aldehydes (n=4-10), benzaldehyde, ethanol, isopropanol, and n-propanol adsorbed on a dual-bed graphitized carbon/carbon molecular sieve adsorbent cartridge. Journal of Chromatography A 929 (1-2):89-100 (2001). EPA/600/J-02/124.

9/1/2001

Contact: William A. McClenny

Abstract: Ozone reacts with n-aldehydes (n = 4 - 10), benzaldehyde, ethanol, isopropanol, and n-propanol adsorbed on a dual-bed graphitized carbon/carbon molecular sieve adsorbent cartridge. Destruction of n-aldehydes increases with n number and with ozone concentration. In some sampling experiments both generation and destruction of n-aldehydes by ozone are observed. In field experiments the results of sample analysis for n-aldehydes and benzaldehyde are frequently not proportional to sample volume whereas results for toluene and isoprene, and sometimes for total carbon, are. A simple theory is developed to simulate the net result of three processes: the adsorption of compounds from an air stream onto a solid adsorbent, the generation of compounds by reaction of ozone with materials upstream of or on the adsorbent, and the destruction by ozone of pre-existing compounds and compounds adsorbed from the sample stream. The use of distributed volume pairs is recommended as a way to identify loss of sample integrity during air monitoring experiments. This work has been funded in part by the United States Environmental Protection Agency (EPA) under contract 68-D5-0049 to ManTech Environmental Technology, Inc. It has been subjected to Agency review and approved for publication. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

Jan 1, 2001 - Dec 31, 2001

Presented Published

Liu, S., and Pleil, J.D. Optimized determination of trace jet fuel volatile organic compounds in human blood using in-field liquid-liquid extraction with subsequent laboratory gas chromatographic-mass spectrometric analysis and on-column large volume injection. *Journal of Chemical and Engineering Data* 752 (1):159-171 (2001). EPA/600/J-01/267.

3/5/2001

Contact: Joachim D. Pleil

Abstract: A practical and sensitive method to assess volatile organic compounds (VOCs) from JP-8 jet fuel in human whole blood was developed by modifying previously established liquid-liquid extraction procedures, optimizing extraction times, solvent volume, specific sample processing techniques, and a new on-column large volume injection method for GC/MS analysis. With the optimized methods, the extraction efficiency was improved by 4.3 to 20.1 times and the detection sensitivity increased up to 660 times over the standard method. Typical detection limits in the parts-per-trillion (ppt) level range were achieved for all monitored JP-8 constituents; this is sufficient for assessing human fuels exposures at trace environmental levels as well as occupational exposure levels. The sample extractions are performed in the field and only solvent extracts need be shipped to the laboratory. The method is implemented with standard biological laboratory equipment and a modest bench-top GC-MS system. This work was funded by the National Exposure Research Laboratory, US Environmental Protection Agency (EPA), through Contract 68-D5-0049 with ManTech Environmental Technology, Inc. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

Buckley, T.J., Pleil, J.D., Bowyer, J.R., and Davis, J.M. Evaluation of methyl tert-butyl ether (MTBE) as an interference on commercial breath-alcohol analyzers. *Forensic Science International* 123 (2-3):111-118 (2001). EPA/600/J-02/066.

12/1/2001

Contact: Joachim D. Pleil

Abstract: Anecdotal reports suggest that high environmental or occupational exposures to the fuel oxygenate methyl tert-butyl ether (MTBE) may result in breath concentrations that are sufficiently elevated to cause a false positive on commercial breath-alcohol analyzers. We evaluated this possibility in vitro by establishing a response curve for simulated breath containing MTBE in ethanol. Two types of breath-alcohol analyzers were evaluated. One analyzer's principle of operation involves in situ wet chemistry (oxidation of ethanol in a potassium dichromate solution) and absorption of visible light. The second instrument uses a combination of infrared absorption and an electrochemical sensor. Both types of instruments are currently used, although the former method represents older technology while the latter method represents newer technology. The percent blood alcohol response curve was evaluated over a breath concentration range thought to be relevant to high-level environmental or occupational exposure (0-361 g/L). Results indicate that MTBE positively biases the response of the older technology Breathalyzer™ when evaluated as a single constituent or in combination with ethanol. We conclude that a false positive is possible on this instrument if the MTBE exposure is very high, recent with respect to testing, and occurs in combination with ethanol consumption. The interference can be identified on the older technology instrument by a time dependent post-reading increase in the instrument response that does not occur for ethanol alone. In contrast, the newer technology instrument using infrared and electrochemical detectors did not respond to MTBE at lower levels (0-36 g/L), and at higher levels (>72 g/L) the instrument indicated an "interference" or "error". For this instrument, a false positive does not occur even at high MTBE levels in the presence of ethanol. This paper has been reviewed in accordance with the US Environmental Protection Agency's peer and administrative review policies and approved for publication. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

Jan 1, 2001 - Dec 31, 2001

Presented Published

Skelly, J.M., Ferdinand, J.A., Jagodzinski, J.A., Savage, J.E., and Mulik, J.D. A 13-week comparison of passive and continuous ozone monitors at forested sites in North-Central Pennsylvania. Journal of the Air & Waste Management Association 51 (9):1280-1287 (2001). EPA/600/J-02/217.

9/1/2001

Contact: Avis P. Hines

Abstract: Ogawa passive O₃ samplers were used in a 13-233k study (June 1-September 1, 1999) involving 11 forested and mountaintop sites in north-central Pennsylvania. Four of the sites were collocated with TECO model 49 O₃ analyzers. A significant correlation ($p < 0.0001$) was found for 24-hr average weekly O₃ concentrations between the two methodologies at the four sites with collocated monitors. As expected, there were positive relationships between increasing elevation of the sites and increasing O₃ concentrations. No O₃ exposure patterns were found on a west-to-east or south-to-north basis; however, the area known for lower O₃ exposures within a smaller subsection of the study area showed consistently lower O₃ exposures. Preliminary results regarding relationships of symptom responses within O₃-sensitive bioindicators are also presented with black cherry (*Prunus serotina*, Ehrh.) and common milkweed (*Asclepias syriaca*, L.) showing clear evidence of increasing injury with increasing O₃ exposures. Due to the extremely dry conditions encountered in north-central Pennsylvania during the 1999 growing season, O₃-induced symptoms were sporadic and quite delayed until late-season rains during the latter portion of the observations period.

Leone, A.D., Ulrich, E.M., Bodnar, C.E., Falconer, R.L., and Hites, R.A. Organochlorine pesticide concentrations and enantiomer fractions for chlordane in indoor air from the U.S. cornbelt. Atmospheric Environment 34 (24):4131-4138 (2001). EPA/600/J-01/097.

7/1/2001

Contact: Renee L. Falconer

Abstract: Thirty-seven indoor air samples were collected and analyzed to determine if enantioselective degradation of past use organochlorine pesticides occurs indoors and to increase the available information on concentrations in homes. Samples were collected from homes in the U.S. cornbelt region and analyzed for the concentrations of eleven pesticides and the enantiomer signature of chlordanes. Residues were found for all pesticides analyzed in at least several of the samples, with chlordane dominating in most samples. Racemic residues were seen for the chlordane enantiomers in all samples. Since levels of organochlorine pesticides in urban areas are often an order of magnitude above ambient levels, emissions from house foundations may be a source of these compounds to ambient air. Past research has shown selective enantiomeric degradation occurs in many environmental samples resulting in non-racemic residues. Knowledge of the enantiomer signatures of chlordane and other pesticides in different media may be useful for distinguishing sources of chlordane to ambient air. This work was supported in part by a contract from the Canadian Atmospheric Environment Service. The research described herein was conducted independently of the corresponding author's EPA employment and has not been subjected to the Agency's peer and administrative review. Therefore, the conclusions and opinions are solely those of the author and should not be construed to reflect the views of the Agency.

Nishioka, M.G., Lewis, R.G., Brinkman, M.C., Burkholder, H.M., Hines, C.E., and Menkedick, J.R. Distribution of 2,4-D in air and on surfaces inside residences following lawn applications: comparing exposure estimates for young children from various media. Environmental Health Perspectives 109 (11):1185-1191 (2001). EPA/600/J-02/123.

11/1/2001

Contact: Robert G. Lewis

Abstract: Indoor air, surface wipes (floors, table tops and window sills) and floor dust samples were collected at multiple locations within 11 occupied and 2 unoccupied homes both prior to and following lawn application of the herbicide 2,4-D. Residue measurements were made over periods of 1 week pre- and post-application. Collected samples were used to determine transport routes of 2,4-D from the lawn into the homes, its subsequent distribution between the indoor surfaces, and air concentration as a function of airborne particle size. Residue measurements were used to estimate potential exposures within these homes. Following the lawn application, 2,4-D was detected in indoor air and on all surfaces throughout all homes. Track-in by an active dog and the homeowner applicator were the most significant factors for intrusion. Resuspension of floor dust was the major source of 2,4-D in indoor air, with highest levels of 2,4-D found in the particle size range of 2.5 μ m to 10 μ m. Resuspended floor dust was also a major source of 2,4-D on tables and window sills. Estimated post-application indoor exposure levels for young children from non-dietary ingestion may be 1-10 μ g/day from contact with floors, and 0.2-30 μ g/day from contact with table tops. These are estimated to be about 10 times higher than the pre-application exposures. By comparison, dietary ingestion of 2,4-D is approximately 1.3 μ g/day.

Jan 1, 2001 - Dec 31, 2001

Presented Published

Rodes, C.E., Newsome, R.J., Vanderpool, R.W., Antley, J.T., and Lewis, R.G. Experimental methodologies and preliminary transfer factor data for estimation of dermal exposures to particles. *Journal of Exposure Analysis and Environmental Epidemiology* 11 (2):123-139 (2001). EPA/600/J-01/179.

6/21/2001

Contact: Robert G. Lewis

Abstract: Developmental efforts and experimental data are described that focused on quantifying the transfer of particles on a mass basis from indoor surfaces to human skin. Methods were developed that utilized a common fluorescein-tagged Arizona Test Dust (ATD) as a possible surrogate for housedust and a uniform surface dust deposition chamber to permit estimation of particle mass transfer for selected dust size fractions. Particle transfers to both wet and dry skin were quantified for contact events with stainless steel, vinyl, and carpeted surfaces that had been pre-loaded with the tagged test dust. To better understand the representativeness of the test dust, a large housedust sample was collected and analyzed for particle size distribution by mass, and several metals (Pb, Mn, Cd, Cr, and Ni). The real housedust sample was found to have multi-modal size distributions (in mg/g) for particle-phase metals. The fluorescein tagging provided surface coatings of 0.11 to 0.36 ng fluorescein/g dust. The predominant surface location of the fluorescein tag would best represent simulated mass transfers for contaminant species coating the surfaces of the particles. The computer-controlled surface deposition chamber provided acceptably uniform surface coatings with known particle loadings on the contact test panels. Significant findings for the dermal transfer factor data were: (a) only about 1/3 of the projected hand surface typically came in contact with the smooth test surfaces during a press, (b) the fraction of particles transferred to the skin decreased as the surface roughness increased, with carpeting transfer coefficients averaging only one-tenth those of stainless steel, (c) hand dampness significantly increased the particle mass transfer, (d) consecutive presses decreased the particle transfer by a factor of three as the skin surface became loaded, requiring ~100 presses to reach an equilibrium transfer rate, and (e) an increase in metals concentration with decreasing particle size, with levels at 25 μ m typically two or more times higher than those at 100 μ m - consistent with the earlier finding of Lewis et al., 1999 for the same sample for pesticides and PAH's. The U. S. Environmental Protection Agency through its Office of Research and Development partially funded, assisted in the management, and collaborated in the research described here under contract 68-D5-0040-WA023 to the Research Triangle Institute. It has been subjected to Agency review and approved for publication. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

Colon, M., Pleil, J.D., Hartlage, T.A., Guardani, M.L., and Martins, M.H. Survey of volatile organic compounds associated with automotive emissions in the urban airshed of Sao Paulo, Brazil. *Atmospheric Environment* 35 (23):4017-4031 (2001). EPA/600/J-01/251.

8/22/2001

Contact: Joachim D. Pleil

Abstract: The Metropolitan Region of Sao Paulo (MRSP), Brazil, is one of the largest metropolitan areas in the world (population 17 million, approx.) and relies heavily on alcohol-based fuels for automobiles. It is estimated that about 40% of the total volume of fuel is ethanol with some vehicles using pure ethanol and others a gasoline/ethanol blend. As such, Sao Paulo is an excellent example of an oxygenates-dominated airshed of mobile sources and is most likely indicative of the future in heavily populated areas in the U.S. such as Los Angeles where "oxy fuels" are becoming an important replacement for the conventional pure petroleum-based fuels. In this work, we surveyed the ambient air to identify and quantify the organic compounds associated with the evaporative and exhaust emissions of these fuels and to begin to understand the potential for human exposure. Because this was an initial test without detailed prior knowledge of the air shed of the area, we applied two different air sampling methods for various time periods to assess the ambient concentrations of a variety of polar and nonpolar volatile organic compounds (VOCs). For quality assurance (QA), we collected all the samples in duplicate (whole-air samples in Summa canisters and adsorbent-based samples on Carbotrap/Carboxen 1000 tubes) at various flow rates to test performance. All samples were collected over identical time frames, typically for 1-, 2-, and 4-h periods per day at six different locations over a period of 1 week. Overall Sao Paulo results demonstrate that mean concentrations of single-ring aromatics are 2 to 3 times higher, volatile aldehydes are 5 to 10 times higher, and simple alcohols 10 to 100 times higher as compared to results of a recent study performed by EPA in the Los Angeles basin. C4 to C11 n-alkanes were only slightly elevated in Sao Paulo. The scientific portion of this work was funded by EPA, including infrastructure support from ManTech Environmental Technology, Inc., under EPA Contract 68-D5-0049 for calibration and quality assurance standards. This work has been subjected to EPA review and approved for publication. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

Jan 1, 2001 - Dec 31, 2001

Presented Published

Harper, S.L., and Gutknecht, W.F. Sources of variability in collection and preparation of paint and lead-coating samples. Journal of Environmental Monitoring 3 (3):335-340 (2001). EPA/600/J-01/180.

6/25/2001

Contact: Sharon L. Harper

Abstract: Chronic exposure of children to lead can result in permanent physiologic impairment. Since surfaces coated with lead-containing paints and varnishes are potential sources of exposure, it is extremely important that reliable methods for sampling and analysis be available. The sources of variability in the collection and preparation of samples were investigated to improve the performance and comparability of methods and to ensure that data generated will be adequate for its intended use. Paint samples of varying sizes (areas and masses) were collected at different locations across a variety of surfaces including metal, plaster, concrete, and wood. Homogenization and subsampling steps were found to be the principal sources of variability related to the size of the sample collected. A variety of grinding techniques were compared. Manual mortar and pestle grinding for at least 1.5 minutes and mechanized grinding techniques were found to generate similar homogenous particle size distributions required for aliquots as small as 100 mg. When 342 samples were evaluated for sample weight loss during mortar and pestle grinding, 4% had 20% or greater loss with a high of 41%. Analysis of samples from different locations on apparently identical surfaces were found to vary by more than a factor of 2 both in lead (Pb) concentration (mg cm⁻² or %) and areal coating density (g cm⁻²). Analyses of substrates were performed to determine Pb remaining after coating removal. Levels as high as 1% Pb were found in some substrate samples, corresponding to more than 35 mg cm⁻² Pb. In conclusion, these sources of variability must be considered in development and/or application of any sampling and analysis methodologies. This research was funded by the U.S. Environmental Protection Agency under contracts 68-D1-0009 and 68-D5-0040. This work has been reviewed in accordance with the U.S. Environmental Protection Agency's peer and administrative review process and approved for presentation and publication. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

Lewis, R.G., Fortune, C.R., Blanchard, F.T., and Camann, D.E. Movement and deposition of two organophosphorus pesticides within a residence after interior and exterior applications. Journal of the Air & Waste Management Association 51 (3):339-351 (2001). EPA/600/J-01/126.

3/1/2001

Contact: Robert G. Lewis

Abstract: Post-application temporal and spatial distributions of two organophosphorus pesticides, diazinon and chlorpyrifos, were monitored after homeowner applications for indoor and outdoor insect control. Samples were taken before and up to 12 days after treatments in the family room, kitchen and child's bedroom of indoor air, vacuumable carpet dust, carpet dislodgeable residues, deposits on bare floors, table tops and dinnerware, surrogate food, and residues on children's hands and toys. Results from the study demonstrate the nature and magnitude of translocation of pesticides from the areas of application to surfaces accessible for human contact and permit comparisons of potential exposures via respiration and dermal contact/oral ingestion. Potential indoor inhalation exposures were estimated to be as high as 0.5 ug/kg/d for diazinon applied indoors and 0.05 ug/kg/d for chlorpyrifos applied to the outside perimeter of the house. While ingestion of carpet dust at the rate of 100 mg/d would have added a maximum of only about 0.01 ug/kg/d to the daily dose, residues found on the children's hands suggest that repeated mouthing could have contributed as much as 1 to 1.5 ug/kg/d. These estimates are below the Environmental Protection Agency (EPA) reference dose for chlorpyrifos, but exceed those for diazinon. This work has been funded wholly or in part by the U.S. Environmental Protection Agency under contract 68-D5-0049 to ManTech Environmental Technology, Inc. It has been subjected to Agency review and approved for publication.

Jan 1, 2001 - Dec 31, 2001

Presented Published

Vette, A.F., Rea, A.W., Lawless, P.A., Rodes, C.E., Evans, E.G., Highsmith, V.R., Creason, J.P., and Sheldon, L.S. Characterization of indoor-outdoor aerosol concentration relationships during the Fresno PM exposure studies. *Aerosol Science and Technology* 34 (1):118-126 (2001). EPA/600/J-01/114.

5/8/2001

Contact: Linda S. Sheldon

Abstract: Particle size distributions were measured indoors and outdoors of a single, detached residence during the Fresno particulate matter exposure studies in winter (February 1-28, 1999) and spring (April 18-May 16, 1999). Data was collected for particle sizes ranging from about 0.01 to 2.5 μm . These data were used to investigate the temporal relationships between indoor and outdoor aerosol concentrations and to determine particle deposition rates and penetration factors for discrete particle sizes. Indoor/outdoor aerosol concentration ratios for particle sizes $> 1 \mu\text{m}$ were diurnally variable with highest ratios occurring during daytime (6:00-18:00) due to resuspension from indoor activities. Daytime and nighttime (19:00-7:00) aerosol concentration ratios were very similar for particle sizes $< 1 \mu\text{m}$. Particle deposition rates were determined by measuring the decay in indoor aerosol concentrations after indoor levels were elevated by infiltration of native ambient aerosols. Deposition rates varied depending on particle size and were consistent with model results up to about 0.4 μm . The experimentally determined deposition rates were considerably higher than model results at larger particle sizes, suggesting the possibility of an additional indoor loss mechanism. Penetration factors were determined to be less than unity for all particle sizes and ranged from 0.5 to 0.9. The U.S. Environmental Protection Agency through its Office of Research and Development funded and managed the research described here under contract #68-D5-0040 to the Research Triangle Institute. It has been subjected to agency review and approved for publication. Mention of trade names or commercial products does not constitute an endorsement or recommendation for use.

Klepeis, N., Nelson, W.C., Ott, W.R., Robinson, J.P., Tsang, A.M., Switzer, P., Behar, J.V., Hern, S.C., and Engelmann, W.H. The national human activity pattern survey (NHAPS): a resource for assessing exposure to environmental pollutants. *Journal of Exposure Analysis and Environmental Epidemiology* 11 (3):231-252 (2001). EPA/600/J-01/351.

5/1/2001

Contact: William C. Nelson

Abstract:

Morgan, M.K., Stout, II, D.M., and Wilson, N.K. A feasibility study of the potential for human exposure to pet-borne diazinon residues following lawn applications. *Bulletin of Environmental Contamination and Toxicology* 66 (3):295-300 (2001). EPA/600/J-01/276.

9/5/2001

Contact: Vance R. Highsmith

Abstract: Diazinon (O,O-diethyl-O-[2-isopropyl-6-methylpyrimidin-4-yl]phosphorothioate) is a broad spectrum organophosphorus insecticide commonly used to control a variety of pest insects (ticks, grubs, ants, and fleas) on lawns (Earl et al. 1971; Tomlin, 1994). Recently, Stout II (1998) showed an association between applications of insecticides to the exterior perimeter of residential dwellings and residues measured inside the homes. His results suggest that pesticide residues intrude readily into living areas by translocation as vapors and/or by track-in, depending on the pesticides' physical characteristics. Nishioka et al. (1997) showed that foot traffic through pesticide (2,4-D) treated turf was a significant mechanism for transport of this lawn-applied pesticide into homes. In a subsequent examination of homes receiving pesticide applications to turf, Nishioka et al. (1999) found that carpet dust collected from homes having high child and pet activity had greater levels of pesticide residues than homes having low child and pet activity. These findings suggest that familial factors, such as the activities of children and specifically pets, might serve as an important vehicle for transport of turf-applied pesticides into dwellings. Nishioka's results also suggest that the activity of pets greatly exceeds all other routes of transport for such residues. Furthermore, residues tracked into the home by indoor/outdoor pets, such as family dogs, may be deposited onto surfaces and volatilize or be resuspended into air, potentially exposing occupants. Pets may also transfer pollutants to humans through direct intimate contact (for example, petting, playing, kissing, licking and resting on laps). The objectives of this study were 1) to investigate the potential for an indoor/outdoor pet dog to transport and translocate diazinon residues into a residence following a lawn application, 2) to determine if intimate contacts between a pet dog and occupants resulted in measurable exposures, and 3) to determine if a pet dog could be a good indicator of exposure following a lawn application of diazinon. This work has been funded wholly or in part by the United States Environmental Protection Agency. It has been subjected to Agency review and approved for publication. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

Jan 1, 2001 - Dec 31, 2001

Presented Published

9/1/2001

Rea, A.W., Zufall, M.J., Williams, R.W., Sheldon, L.S., and Howard-Reed, C. The influence of human activity patterns on personal PM exposure: a comparative analysis of filter-based and continuous particle measurements. Journal of the Air & Waste Management Association 51 (9):1271-1279 (2001). EPA/600/J-01/311.

Contact: Ronald W. Williams

Abstract: Particulate matter (PM) exposure data from the U.S. Environmental Protection Agency sponsored 1998 Baltimore and 1999 Fresno PM Exposure Studies were analyzed to identify important microenvironments and activities that may lead to increased particle exposure for select elderly (>65 years old) subjects. Integrated 24-hour filter-based PM_{2.5} and/or PM₁₀ mass measurements (using Personal Environmental Monitors or PEMs) included personal, indoor and outdoor residential measurements, and measurements at a central indoor site and a community monitoring site. A subset of the participants in each study wore passive nephelometers that continuously measured (1 -min averaging time) particles ranging in size from 0.1 to ~10 μ m. Significant activities and locations were identified by a statistical mixed model ($p < 0.01$) for each study population based on the measured PM_{2.5} or PM₁₀ mass and time activity data. Elevated PM concentrations were associated with traveling (car or bus), commercial locations (store, office, mall, etc.), restaurants, and working. The modeled results were compared to continuous PM concentrations determined by the nephelometers while participants were in these locations. Overall, the nephelometer data agreed within 6% of the modeled PM_{2.5} results for the Baltimore participants and ~20% for the Fresno participants (variability was due to zero drift associated with the nephelometer). The nephelometer did not agree as well with the PM₁₀ mass measurements, most likely because the nephelometer optimally responds to fine particles (0.3-2 μ m). Approximately half (54 \pm or - 31%; mean \pm or std. dev. from both studies) of the average daily PM_{2.5} exposure occurred inside residences, where the participants spent an average of 83 \pm or - 10% of their time. These data also showed that a significant portion of PM_{2.5} exposure occurred in locations where participants spent only 4-13% of their time. The information in this document has been funded wholly or in part by the United States Environmental Protection Agency through Contract #68-D5-0040 to the Research Triangle Institute. It has been subjected to Agency review and approved for publication. Mention of trade names or commercial products does not constitute an endorsement or recommendation for use.

Landis, M.S., Norris, G.A., Williams, R., and Weinstein, J.P. Personal exposure to PM_{2.5} mass and trace elements in Baltimore, MD, USA. Atmospheric Environment 35 (36):6511-6524 (2001). EPA/600/J-02/071.

12/31/2001

Contact: Ronald W. Williams

Abstract: In a recent study, EPA found significant relationships between PM_{2.5} mass measurements at a community site and personal exposure samples in a Towson, MD retirement facility. This manuscript builds upon these results by evaluating the exposure relationships with the elemental composition of the PM_{2.5} mass. Daily community, outdoor, and indoor PM_{2.5} were measured with a URG Versatile Air Pollutant Sampler (VAPS). Daily personal and apartment PM_{2.5} samples were collected with a Marple Personal Exposure Monitor (PEM). Only subjects with the most complete data records ($n=10$) were used in this analysis. Significant differences were found between the VAPS and PEM samplers for PM_{2.5} elemental composition, so all subsequent analyses were conducted independently for each of the data sets. Both the VAPS and PEM samples were analyzed with energy dispersive X-ray fluorescence (XRF). In addition, the VAPS samples were analyzed for pH, major ions, and elemental/organic carbon. The spatial correlation coefficients between the community and outdoor monitor, and the indoor infiltration rates were calculated for several PM_{2.5} constituents calculated from the VAPS samples including: sulfate, nitrate, trace element oxides, soil, and NaCl. The spatial correlations for most PM_{2.5} constituents were good (e.g. sulfate ($r^2 = 0.99$)), with the exception of soil ($r^2 = 0.40$). Infiltration rates of the PM_{2.5} constituents were determined by linear regression analysis and varied according to particle size. Infiltration rates ranged from 0.41 ($r^2 = 0.98$) for sulfate to 0.09 ($r^2 = 0.83$) for nitrate. Outdoor, central indoor, apartment, and personal exposures PEM samples were also evaluated using a linear mixed effects model and median Pearson correlation coefficients. The modeling results indicate that personal exposures to PM_{2.5} and sulfate were strongly associated with outdoor concentrations. Conversely, personal exposures to soil and trace element oxides were not significantly correlated to outdoor concentrations. This work has been funded wholly or in part by the US Environmental Protection Agency Office of Research and Development. It has been subjected to Agency review and approved for publication. Mention of trade names or commercial products does not constitute an endorsement or recommendation for use.

Jan 1, 2001 - Dec 31, 2001

Presented Published

Rogers, K.R., Apostol, A.B., Madsen, S.J., and Spencer, C.W. Fiber optic biosensor for DNA damage. *Analytica Chimica Acta* 444 (1):51-60 (2001). EPA/600/J-02/064.

10/12/2001

Contact: Kim R. Rogers

Abstract: This paper describes a fiber optic biosensor for the rapid and sensitive detection of radiation-induced or chemically-induced oxidative DNA damage. The assay is based on the hybridization and temperature-induced dissociation (melting curves) of synthetic oligonucleotides. The hybridization pair consists of a biotin labeled 38-mer oligonucleotide immobilized to a streptavidin-coated optical fiber and a fluorescently-labeled near-complementary (2 base mismatch) oligonucleotide reporter sequence. The hybridization-based assay detected 50 nM labeled probe and could be run up to ten times on the same fiber. Melting profiles were sensitive to high energy radiation and to 3-morpholinodinitrobenzimidazole (SIN-1)-generated reactive decomposition products. The dynamic range of the assay for ionizing radiation extends from 20cGy to 1000 cGy. Oxidative damage induced by SIN-1 was measured over a concentration range of 250 microM to 3 mM. The US Environmental Protection Agency (EPA), through its Office of Research and Development (ORD), funded this research through a competitive internal grant (to K. R. Rogers). It has been subject to the EPA's peer and administrative review has been approved for publication. Mention of trade names or commercial products does not constitute endorsement or recommendation by EPA for use.

Johnson, J.C., Van Emon, J.M., Clarke, A.N., and Wamsley, B.N. Quantitative ELISA of polychlorinated biphenyls in an oily soil matrix using supercritical fluid extraction. *Analytica Chimica Acta* 428 (2):191-199 (2001). EPA/600/J-01/297.

9/18/2001

Contact: Jeanette M. Van emon

Abstract: Soil samples from the GenCorp Lawrence Brownfields site were analyzed with a commercial semi-quantitative enzyme-linked immunosorbent assay (ELISA) using a methanol shake extraction. Many of the soil samples were extremely oily, with total petroleum hydrocarbon levels up to 240 g kg⁻¹, as determined by EPA Method 418.1. Commercial immunoassay results did not agree with confirmatory results obtained by gas chromatographic (GC) analysis of conventional Soxhlet extracts. Sample splits were subsequently extracted using both a methanol shake extraction and a methanolic Soxhlet extraction and analyzed by a quantitative PCB ELISA which has been previously described. The ELISA results for both types of extracts did not agree with GC confirmatory data except for the less oily samples. The current work reports re-analysis of these samples using supercritical fluid extraction (SFE) coupled to the same quantitative ELISA. Good agreement between GC results and SFE ELISA results was obtained. The US Environmental Protection Agency through its Office of Research and Development funded the research described here. It has been subjected to Agency review and approved for publication. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

Jan 1, 2001 - Dec 31, 2001

Presented Published

Dary, C.C., Blancato, J.N., and Saleh, M.A. Chemomorph analysis of malathion in skin layers of the rat: implications for the use of dermatopharmacokinetic (DPK) tape stripping in exposure assessment to pesticides. Regulatory Toxicology and Pharmacology 34 (3):234-248 (2001). EPA/600/J-02/213.

12/1/2001

Contact: Curtis C. Dary

Abstract: The dermatopharmacokinetic (DPK) method of dermal tape stripping may prove to be a valuable addition to risk assessment protocols for toxic substances as it has been for the assessment of bioequivalence and bioavailability of topical dermatologic drugs. The measurement of drug penetration into stratum corneum (SC) with respect to time is thought to be comparable with drug distribution in underlying tissues. To examine this possibility, the dermal penetration and absorption characteristics of [¹⁴C]malathion in the Sprague-Dawley rat was examined by three analytical techniques. [¹⁴C]Malathion was applied in different vehicles for 30-min and 1-h periods of exposure. Penetration into the SC was assessed by tape stripping followed by instant electronic autoradiography (IEA). Also, the ¹⁴C activity retained in three successive 16 um sections of the skin application site was determined by IEA and malathion was identified by Fourier transform infrared microscopy (FTIR microscopy). Absorbed [¹⁴C]malathion was measured in selected tissues, organs, and the residual carcass by liquid scintillation counting (LSC). Penetration into the SC followed a linear trend. The capacity of the SC reservoir for malathion amounted to approximately 1% of the dermal dose, while approximately 6% of the dose was absorbed. Results from this study support the view that LSC remains the method of choice to efficiently and reliably quantify absorption of a radiolabeled test substance. IEA offers the ability of the user to visualize the extent and profile of dermal absorption. When IEA is combined with FTIR microscopy, an effectual tool for studying the penetration of chemicals into layers of the skin emerges. The combined use of the three analytical techniques can be used to test the validity of the DPK method in hazard evaluation and exposure assessment of the organophosphorus insecticides. This work was partially supported by the National Institutes of Health research centers in minority institution (RCMI) under grant #RR03045-12A. Additional funding was provided by the U.S. Environmental Protection Agency (U.S. EPA) through the Office of Research and Development (ORD) under cooperative agreement #CR818220-02-5.

Gerlach, R.W., Gustin, M.S., and Van Emon, J.M. On-site mercury analysis of soil at hazardous waste sites by immunoassay and ASV. Applied Geochemistry 16 (3):281-290 (2001). EPA/600/J-01/062.

1/1/2001

Contact: Jeanette M. Van emon

Abstract: Two field methods for Hg, immunoassay and anodic stripping voltammetry (ASV), that can provide onsite results for quick decisions at hazardous waste sites were evaluated. Each method was applied to samples from two Superfund sites that contain high levels of Hg; Sulphur Bank Mercury Mine site, Clear Lake, California, and Carson River Mercury site, Nevada. Two laboratory methods were used for comparison purposes; cold vapor atomic fluorescence spectrometry (CVAFS) and inductively coupled plasma-mass spectrometry (ICP-MS). The immunoassay was found to be accurate for high and low Hg concentrations compared to the 5 and 15 ug/g soil sample standards provided with it. Despite poor agreement between immunoassay and confirmatory analysis results at concentrations near the comparison standards, the immunoassay could be used as an effective screening method provided care is taken in identifying an operational screening level. The ASV method had an analytical range of 1-50 ug/g, with a CV of 15%. ASV results were comparable to CVAFS (CV=15%) and more precise than ICP-MS (CV=20%). The lower limit of quantitative results was 3 ug/g for field samples, and is attributed to uncertainty associated with sampling. The US Environmental Protection Agency (EPA) through its Office of Research and Development (ORD), funded and collaborated in the research described here. It has been subjected to the Agency's peer review system and has been approved as an EPA publication. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

Jan 1, 2001 - Dec 31, 2001

Presented Published

Van Emon, J.M. Immunochemical applications in environmental science. Journal of AOAC International 84 (1):125-133 (2001). EPA/600/J-01/113.

5/8/2001

Contact: Jeanette M. Van emon

Abstract: Immunochemical methods are based on selective antibodies combining with a particular target analyte or analyte group. The specific binding between antibody and analyte can be used to detect environmental contaminants in a variety of sample matrixes. Immunoassay methods provide cost-effective, sensitive, and selective analyses for many compounds of environmental and human health concern. Immunoaffinity chromatography methods have been integrated with chromatographic methods and are also being used as efficient sample preparations prior to immunochemical or instrumental detection. Immunosensors show promise in obtaining rapid online analyses. These and other advancements in immunochemical methods continue the expansion of their role from field screening methods to highly quantitative procedures that can be easily integrated into the environmental analytical laboratory. The U.S. Environmental Protection Agency (EPA), through its Office of Research and Development (ORD), funded and collaborated in the research described here. It has been subjected to the Agency's peer review and has been approved as an EPA publication. Mention of trade names or commercial products does not constitute endorsement or recommendation by the EPA for use.

Rogers, K.R., Becker, J.Y., Cembrano, J., and Chough, S.H. Viscosity and binder composition effects on tyrosinase-based carbon paste electrode for detection of phenol and catechol. Talanta 54 (6):1059-1065 (2001). EPA/600/J-01/274.

7/1/2001

Contact: Kim R. Rogers

Abstract: The systematic study of the effect of binder viscosity on the sensitivity of a tyrosinase-based carbon paste electrode (CPE) biosensor for phenol and catechol is reported. Silicon oil binders with similar (polydimethylsiloxane) chemical composition were used to represent a wide range of viscosities (10 to 60,000 mPa.s at 25 °C) while minimizing polarity effects. The highest response for both phenol and catechol was achieved using a silicon oil binder of intermediate viscosity (100 mPa.s). The binder viscosity showed no appreciable effect on the direct oxidation of phenol and catechol using a plain CPE, suggesting the involvement of diffusion kinetics in the binder matrix for the enzyme-based CPE. The effect of the relative binder concentration in the carbon paste was measured over the range of 30-70%. Optimal results were obtained using 40% silicon oil. For comparison of the viscosity effects observed with the carbon paste electrode (CPE) containing silicon oil, other low and high viscosity mineral oils and paraffin waxes were also examined. The U.S. Environmental Protection Agency (EPA), through its Office of Research and Development (ORD), funded this research. It has been subject to the EPA's peer and administrative review has been approved for publication. Mention of trade names or commercial products does not constitute endorsement or recommendation by EPA for use. J.Y. Becker gratefully acknowledges support from the EPA through the National Research Council Senior Fellowship Awards Program.

Jan 1, 2001 - Dec 31, 2001

Presented Published

Moschandreas, D.J., Kim, Y., Karuchit, S., Ari, H., Lebowitz, M.D., O'Rourke, M.K., Gordon, S.M., and Robertson, G.L. In-residence, multiple route exposures to chlorpyrifos and diazinon estimated by indirect method models. *Atmospheric Environment* 35 (12):2201-2213 (2001). EPA/600/J-01/232.

4/1/2001

Contact: Gary L. Robertson

Abstract: One of the objectives of the National Human Exposure Assessment Survey (NHEXAS) is to estimate exposures to several pollutants in multiple media and determine their distributions for the population of Arizona. This paper presents modeling methods used to estimate exposure distributions of chlorpyrifos and diazinon in the residential microenvironment using the database generated in Arizona (NHEXAS-AZ). A four-stage probability sampling design was used for sample selection. Exposures to pesticides were estimated using the indirect method of exposure calculation by combining measured concentrations of the two pesticides in multiple media with questionnaire information such as time subjects spent indoors, dietary and non-dietary items they consumed, and areas they touched. Most distributions of in-residence exposure to chlorpyrifos and diazinon were lognormal or nearly lognormal. Exposures to chlorpyrifos and diazinon vary by pesticide and route as well as by various demographic characteristics of the subjects. Comparisons of exposure to pesticides were investigated among subgroups of demographic categories, including gender, age, minority status, education, family income, household dwelling type, year the dwelling was built, pesticide use, and carpeted areas within dwellings. Residents with large carpeted areas within their dwellings have higher exposures to both pesticides for all routes than those in less carpet-covered areas. Depending on the route, several other determinants of exposure to pesticides were identified, but a clear pattern could not be established regarding the exposure differences between several subpopulation groups. Preparation of this document has been funded wholly or part by the United States Environmental Protection Agency under Contract 68-D-99-003 to the University of Arizona. It has been subjected to Agency review and approved for publication. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

Adgate, J.L., Barr, D., Clayton, C.A., Eberly, L.E., Freeman, N.C.G., Liroy, P.J., Needham, L., Pellizzari, E.D., Quackenboss, J.J., Roy, A., and Sexton, K.G. Measurement of children's exposure to pesticides: analysis of urinary metabolite levels in a probability-based sample. *Environmental Health Perspectives* 109 (6):583-590 (2001). EPA/600/J-01/230.

6/1/2001

Contact: James J. Quackenboss

Abstract: The Minnesota Children's Pesticide Exposure Study is a probability-based sample of 102 children 3-13 years old who were monitored for commonly used pesticides. During the summer of 1997, first-morning-void urine samples (1-3 per child) were obtained for 88% of study children and analyzed for metabolites of insecticides and herbicides: carbamates and related compounds (1-NAP), atrazine (AM), malathion (MDA), and chlorpyrifos and related compounds (TCPy). TCPy was present in 93% of the samples, whereas 1-NAP, MDA, and AM were detected in 45%, 37%, and 2% of samples, respectively. Measured intrachild means ranged from 1.4 &mgr;g/L for MDA to 9.2 &mgr;g/L for TCPy, and there was considerable intrachild variability. For children providing three urine samples, geometric mean TCPy levels were greater than the detection limit in 98% of the samples, and nearly half the children had geometric mean 1-NAP and MDA levels greater than the detection limit. Interchild variability was significantly greater than intrachild variability for 1-NAP ($p = 0.0037$) and TCPy ($p < 0.0001$). The four metabolites measured were not correlated within urine samples, and children's metabolite levels did not vary systematically by sex, age, race, household income, or putative household pesticide use. On a log scale, mean TCPy levels were significantly higher in urban than in nonurban children (7.2 vs. 4.7 &mgr;g/L; $p = 0.036$). Weighted population mean concentrations were 3.9 [standard error (SE) = 0.7; 95% confidence interval (CI), 2.5, 5.3] &mgr;g/L for 1-NAP, 1.7 (SE = 0.3; 95% CI, 1.1, 2.3) &mgr;g/L for MDA, and 9.6 (SE = 0.9; 95% CI, 7.8, 11) &mgr;g/L for TCPy. The weighted population results estimate the overall mean and variability of metabolite levels for more than 84,000 children in the census tracts sampled. Levels of 1-NAP were lower than reported adult reference range concentrations, whereas TCPy concentrations were substantially higher. Concentrations of MDA were detected more frequently and found at higher levels in children than in a recent nonprobability-based sample of adults. Overall, Minnesota children's TCPy and MDA levels were higher than in recent population-based studies of adults in the United States, but the relative magnitude of intraindividual variability was similar for adults and children. This abstract has been reviewed in accordance with the United States Environmental Protection Agency's peer and administrative review policies and approved for presentation.

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Presented Published

Rigas, M.L., Okino, M.S., and Quackenboss, J.J. Use of pharmacokinetic model to assess chlorpyrifos exposure and dose in children based on urinary biomarker measurements. Toxicological Sciences 61 (0):374-381 (2001). EPA/600/J-01/284.

9/17/2001

Contact: Marc L. Rigas

Abstract: Chlorpyrifos is a common agricultural insecticide and has been used residentially in the United States until 2000 when this use was restricted by the U.S. Environmental Protection Agency (U.S. EPA). A chlorpyrifos metabolite, 3,5,6-trichloro-2-pyridinol (TCPy) has been found in urine samples collected during exposure field studies. In this work, we use urinary biomarker data and the inverse solution of a simple pharmacokinetic (PK) model for chlorpyrifos to estimate the magnitude and timing of doses. Three urine samples were collected on separate days from each of 15 children (Ages 3 - 12) who were participants in the Minnesota Children Pesticide Exposure Study (MNCPEs). The total volume of urine was noted and samples analyzed for TCPy. The urinary data was used along with constraints imposed on dose timing based on responses of the individuals to pesticide-use surveys. We predict the time and magnitude of multiple "event" exposures characterized by short-term relatively high doses superimposed over a continuous background exposure. The average dose of chlorpyrifos predicted by the model was 1.61 ug/kg per reported event. Average background dose rate for these children that reported exposure events was 0.0062 ug/kg/h, or 0.15 ug/kg/day. In addition to predicting the total dose of chlorpyrifos received by an individual from urinary biomarker measurements, the model can then be run in a forward manner once the exposure regime is determined. This will allow the prediction of the total amount of TCPy eliminated in the urine over any time period of interest. The U.S. Environmental Protection Agency through its Office of Research and Development funded the research described here. It has been subject to Agency review and approved for publication. Mention of trade names or commercial products does not constitute an endorsement or recommendation for use.

Jan 1, 2001 - Dec 31, 2001

Presented Published

Pellizzari, E.D., Smith, D.J., Clayton, C.A., Michael, L.C., and Quackenboss, J.J. An assessment of the data quality for NHEXAS--Part I: exposure to metals and volatile organic chemicals in Region 5. *Journal of Exposure Analysis and Environmental Epidemiology* 11 (2):140-154 (2001). EPA/600/J-01/236.

7/20/2001

Contact: James J. Quackenboss

Abstract: A National Human Exposure Assessment Survey (NHEXAS) was performed in U.S. Environmental Protection Agency (U.S. EPA) Region V, providing population-based exposure distribution data for metals and volatile organic chemicals (VOCs) in personal, indoor, and outdoor air, drinking water, beverages, food, dust, soil, blood, and urine. One of the principal objectives of NHEXAS was the testing of protocols for acquiring multimedia exposure measurements and developing databases for use in exposure models and assessments. Analysis of the data quality is one element in assessing the performance of the collection and analysis protocols used in NHEXAS. In addition, investigators must have data quality information available to guide their analyses of the study data. At the beginning of the program quality assurance (QA) goals were established for precision, accuracy, and method quantification limits. The assessment of data quality was complicated. First, quality control (QC) data were not available for all analytes and media sampled, because some of the QC data, e.g., precision of duplicate sample analysis, could be derived only if the analyte was present in the media sampled in at least four pairs of sample duplicates. Furthermore, several laboratories were responsible for the analysis of the collected samples. Each laboratory provided QC data according to their protocols and standard operating procedures (SOPs). Detection limits were established for each analyte in each sample type. The calculation of the method detection limits (MDLs) was different for each analytical method. The analytical methods for metals had adequate sensitivity for arsenic, lead, and cadmium in most media but not for chromium. The QA goals for arsenic and lead were met for all media except arsenic in dust and lead in air. The analytical methods for VOCs in air, water, and blood were sufficiently sensitive and met the QA goals, with very few exceptions. Accuracy was assessed as recovery from field controls. The results were excellent (98%) for metals in drinking water and acceptable (75%) for all VOCs except o-xylene in air. The recovery of VOCs from drinking water was lower, with all analytes except toluene (98%) in the 60-85% recovery range. The recovery of VOCs from drinking water also decreased when comparing holding times of <8 and >8 days. Assessment of the precision of sample collection and analysis was based on the percent relative standard deviation (% RSD) between the results for duplicate samples. In general, the number of duplicate samples (i.e., sample pairs) with measurable data were too few to assess the precision for cadmium and chromium in the various media. For arsenic and lead, the precision was excellent for indoor, and outdoor air (<10% RSD) and, although not meeting QA goals, it was acceptable for arsenic in urine and lead in blood, but showed much higher variability in dust. There were no data available for metals in water and food to assess the precision of collection and analysis. The U.S. Environmental Protection Agency (U.S. EPA), through its Office of Research and Development (ORD), funded this research under Cooperative Agreement CR 821902-01-0 and the analysis of results under Contract No. 68-D-99-008. This manuscript has been peer reviewed by EPA and approved for publication. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

Jan 1, 2001 - Dec 31, 2001

Presented Published

Bonanno, L.J., Freeman, N.C.G., Greenberg, M., and Lioy, P.J. Multivariate analysis on levels of selected metals, particulate matter, VOC, and household characteristics and activities from the midwestern states NHEXAS. Applied Occupational and Environmental Hygiene 16 (9):859-874 (2001). EPA/600/J-02/229.

9/1/2001

Contact: James J. Quackenboss

Abstract: Microenvironmental and biological/personal monitoring information were collected during the National Human Exposure Assessment Survey (NHEXAS), conducted in the six states comprising U.S. EPA Region Five. They have been analyzed by multivariate analysis techniques with general household characteristics and activities that influence levels of residential exposure to contaminants. The aims of these analyses were to identify specific suites of characteristics and/or activities that indicate the presence of significant levels of multiple environmental contaminants in residences. Included were cadmium, chromium, arsenic, lead, respirable particulate mass, 1,1,1-trichloroethylene, p-dichlorobenzene, benzene, chloroform, styrene, tetrachloroethylene, toluene, trichloroethylene, m,p-xylene, and o-xylene, and many were measured in multiple media. Residential characteristics and activities were collected using multiple survey instruments. A suite of factor analysis results for level of environmental contamination in residences yielded gasoline, metals in dust and dust mass, solvents, and tobacco smoke as proximate and ultimate residential sources. The analyses on household characteristics identified factors for suburban-type homes, rural homes, older homes, and dilapidated homes. The analyses using residential activity variables yielded factors for the sources gasoline and combustion, and for the activities of construction, cleaning, and cooling. Discriminant analysis linked the volatile organic compounds in the residences to the storage of gas-powered devices that were in the home or attached garage, the use of mothballs, and to the presence of carpets. Residential metals were linked to the presence of chipping paint, window replacement, and smoking, and appeared to classify 33 percent of the participants. Construction and cleaning activities in the home were associated with the potential for elevated levels of particulate mass in the air and on the floor or carpet, and p-dichlorobenzene in indoor air. These classified 50 percent of the participants above. Dilapidated homes and suburban-type homes were associated with specific metals and/or VOC, and the analysis, again, classified about 50 percent of the participants. In some cases multimedia activities classified individual participants. A combination of factor analysis and discriminant analysis demonstrated that residential characteristics and activities can be used as predictors of the presence or absence of VOC and of metals in the residence. This article has not been subjected to review by the U.S. Environmental Protection Agency. The views and opinions expressed are solely those of the authors and do not necessarily reflect the views or policies of the agency.

Lewtas, J., Pang, Y., Booth, D., Reimer, S., Eatough, D.J., and Gundel, L.A. Comparison of sampling methods for semi-volatile organic carbon associated with PM 2.5. Aerosol Science and Technology 34 (1):9-22 (2001). EPA/600/J-01/074.

1/1/2001

Contact: Joellen Lewtas Jungers

Abstract: This study evaluates the influence of denuder sampling methods and filter collection media on the measurement of semi-volatile organic carbon (SVOC) associated with PM2.5. Two types of collection media, charcoal (activated carbon) and XAD, were used both in diffusion denuders and impregnated back-up filters in two different samplers, the VAPS and the PC-BOSS. The two organic diffusion denuders were XAD-coated glass annular denuders and charcoal-impregnated cellulose fiber filter (CIF) denuders. In addition, recently developed XAD-impregnated quartz filters were compared to CIF filters as back-up filter collection media. The two denuder types resulted in equivalent measurement of particulate organic carbon and particle mass. The major difference observed between the XAD and charcoal BOSS denuders is the higher efficiency of charcoal for collection of more volatile carbon. This more volatile carbon does not contribute substantially to the particle mass or SVOC measured as OC on quartz filters downstream of the denuders. This volatile carbon does result in high OC concentrations observed in charcoal filters placed behind quartz filters downstream of the XAD denuders and would result in overestimating the SVOC in that configuration. This paper has been reviewed in accordance with the US Environmental Protection Agency's peer and administrative review policies and approved for publication. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

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Presented Published

Mukerjee, S., Shadwick, D.S., Smith, L., Somerville, M.C., Dean, K.E., and Bowser, J.J.
Techniques to assess cross-border air pollution and application to a U.S.-Mexico border region.
Science of the Total Environment 276 (1-3):205-224 (2001). EPA/600/J-01/234.

7/20/2001

Contact: Shaibal Mukerjee

Abstract: A year-long assessment of cross-border air pollution was conducted in the eastmost section of the US-Mexico border region, known as the Lower Rio Grande Valley, in South Texas. Measurements were conducted on the US side and included fine particle mass (PM_{2.5}) and elemental composition, volatile organic compounds (VOCs) and meteorology. Wind sector analyses of chemical tracers and diagnostic ratios, in addition to principal component analysis (PCA), were initially applied to assess cross-border and overall air shed influences. Linear-angular correlation statistics [Biometrika, 63, (1976), 403-405] and nonparametric multiple comparisons between wind sectors were computed with the particle element data using principal component scores from PCA to determine the direction of source classes. Findings suggest crustal particles and salts carried or stirred by sea breeze winds from a southerly and southeasterly direction from the Gulf of Mexico heavily influenced the elemental composition of the particulate samples. Pair-wise comparisons of wind directions for the principal component scores suggest possible oil combustion influences from utilities or boilers coming from the south and possible coal combustion influences from the north and northwest. The techniques discussed can provide a methodology to assess future ambient levels and cross-border influences in the Valley as conditions change. The information in this document has been funded wholly or in part by the United States Environmental Protection Agency under Contracts 68-D2-0134 to QST Environmental, Inc. and 68-D5-0049 to ManTech Environmental Technology, Inc. It has been subjected to agency review and approved for publication. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

Smith, L., Mukerjee, S., Monroy, G.J., and Keene, F.E. Preliminary assessments of spatial influences in the Ambos Nogales region of the US-Mexican border. Science of the Total Environment 276 (1-3):83-92 (2001). EPA/600/J-01/235.

7/20/2001

Contact: Shaibal Mukerjee

Abstract: Ambient air measurements collected from 1994 to 1995 were used in a preliminary assessment of potential source and spatial influences in the Ambos Nogales border region (Nogales, Arizona, USA and Nogales, Sonora, Mexico). In this assessment, volatile organic compounds (VOC) and particulate matter (PM) species were used from four sites, two on either side of the border. An examination of median levels and principal component analysis indicated the dominance of soil dusts and mobile sources. Pairwise comparisons of sites for VOCs associated with mobile sources revealed statistically significant differences between sites in the central Nogales area vs. the two sites furthest from the border. Particulate lead at Mexican sites was higher and significantly different vs. US sites. Although further analyses are necessary, findings suggest that local and immediate mobile/other anthropogenic and soil dust influences are present throughout Nogales, with particulate lead from leaded motor vehicle exhaust or soldering operations being a possible influence on the Mexican side. The US Environmental Protection Agency through its Office of Research and Development partially funded and collaborated in the research described here under Contract 68-D5-0049 to ManTech Environmental Technology, Inc. It has been subjected to the Agency review and approved for publication. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

Mukerjee, S. Selected air quality trends and recent air pollution investigations in the U.S.-Mexico border region. Science of the Total Environment 276 (1-3):1-18 (2001). EPA/600/J-01/233.

8/1/2001

Contact: Shaibal Mukerjee

Abstract:

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Presented Published

Lindberg, S.E., Brooks, S., Lin, C.J., Scott, K., Meyers, T., Landis, M.S., and Stevens, R.K. Formation of reactive gaseous mercury in the arctic: evidence of oxidation of Hg⁰ to gas-phase Hg-II compounds after arctic sunrise. *Water, Air and Soil Pollution* 1 (5-6):295-302 (2001). EPA/600/J-02/067.

4/1/2001

Contact: Mary Engle

Abstract: We have measured total gaseous mercury concentrations (Hgo) at Point Barrow, Alaska since September 1998 in an effort to determine the geographic extent and reaction mechanism of the so-called mercury depletion events (MDE) previously reported in the high Arctic at Alert, Canada. Hgo has been sampled now for nearly 2 years at Barrow. In September, 1999, we began making the first automated measurements of reactive gaseous mercury (RGM) attempted in the Arctic, along with measurements of Hg accumulation in snowpack to determine the fate of the "depleted" Hgo. During the fall and early winter, Hgo and RGM exhibit only minor variation, Hgo remaining within ~10% of global background, near 1.6-1.8 ng/m³. The MDE periods are quite different, however; within days of Arctic sunrise in January, Hgo exhibits major variations from the mean, rapidly dropping as low as 0.05 ng/m³ and then cycling back to typical levels, sometimes exceeding global background. These events continue throughout Arctic spring, then end abruptly following snowmelt, in early June. Prior to Arctic sunrise, RGM remains near detection (<2 pg/m³), but after sunrise increases dramatically (to levels as high as 900 pg/m³) in synchrony with the "depletion" of Hgo. Both phenomena exhibit a strong diel cycle, in parallel with UV-B. We conclude that MDE's involve rapid in-air oxidation of Hgo to a species of RGM by photochemically-driven reactions, probably involving the same reactive bromine and chlorine compounds involved in ozone destruction. Sharp increases in Hg in the surface snowpack after sunrise coincident with periods of peak RGM suggest surface accumulation of the RGM by dry deposition. This article has been subjected to Agency review and approved for publication.

Rodes, C.E., Lawless, P.A., Evans, G.F., Sheldon, L.S., Williams, R.W., Vette, A.F., Creason, J.P., and Walsh, D.B. The relationships between personal PM exposures for elderly populations and indoor and outdoor concentrations for three retirement center scenarios. *Journal of Exposure Analysis and Environmental Epidemiology* 11 (2):103-115 (2001). EPA/600/J-01/312.

3/1/2001

Contact: Roy B. Zweidinger

Abstract: Personal exposures, indoor and outdoor concentrations, and questionnaire data were collected in three retirement center settings, supporting broader PM-health studies of elderly populations. The studies varied geographically and temporally, with populations studied in Baltimore (MD) in the summer of 1998, and Fresno (CA) in the winter and spring of 1999. The sequential nature of the studies and the relatively rapid review of the mass concentration data after each segment provided the opportunity to modify the experimental designs, including the information collected from activity diary and baseline questionnaires and influencing factors (e.g. HVAC system operation, door and window openings, air exchange rate) measurements. This paper highlights both PM_{2.5} and PM₁₀ personal exposure data and inter-relationships across the three retirement center settings, and identifies the most probable influencing factors. The current limited availability of questionnaire results, and chemical speciation data beyond mass concentration for these studies, provided only limited capability to estimate personal exposures from models and apportion the personal exposure collections to their sources. The mean personal PM_{2.5} exposures for the elderly in three retirement centers were found to be consistently higher than the paired apartment concentrations by 50 to 68%, even though different facility types and geographic locations were represented. Mean personal-to-outdoor ratios were found to 0.70, 0.82, and 1.10, and appeared to be influenced by the time doors and windows were open and aggressive particle removal by the HVAC systems. Essentially identical computed mean PM_{2.5} personal clouds of 3 mg/m³ were determined for the three studies. The proposed significant contributing factors to these personal clouds were re-suspended particles from carpeting, collection of body dander and clothing fibers, personal proximity to open doors and windows, and elevated PM levels in non-apartment indoor microenvironments. This work has been funded in part by the U.S. Environmental Protection Agency under contract 68-D5-0040, work assignments 29, 37, and 41 to the Research Triangle Institute. It has been subjected to Agency Review for policy and approved for peer-reviewed journal submittal. Mention of trade names or commercial products does not constitute an endorsement or recommendation for use.

PUB REPORT

Arnold, J.R., Cohen, R.C., Dennis, R.L., Kronmiller, K.G., Luecken, D.J., McClenny, W.A., and Stutz, J. Recommended methods for ambient air monitoring of NO, NO₂, NO_y, and individual NO_z species. 2001. EPA/600/R-01/005 (NTIS PB2001-104379).

1/3/2001

Contact: William A. McClenny

Abstract:

Jan 1, 2001 - Dec 31, 2001

Presented Published

Colon, M., and Duncan, J.W. Quality assurance performance audit report for the Secretaria del Medio Ambiente Ciudad de Mexico, DF, Mexico red automatica de monitoreo atmosferico (RAMA) air quality monitoring stations. 2001. EPA/600/R-01/038 (NTIS PB2001-108589).

5/11/2001

Contact: Maribel Colon

Abstract: The United States Environmental Protection Agency (U.S. EPA) conducted this evaluation of the air monitoring network, known as RAM (Red Automatica de Monitoreo Atmosferico) at the request of the Mexico City Secretariat of the Environment on October 16-27, 2000. This evaluation was performed in two stages: System Audit and Performance Audit. RAMA is comprised of 32 monitoring stations distributed in the Federal District (21) and Mexico State (11), of which only 14 of those stations were evaluated during the year 2000 audit. These stations contain monitors for measuring and recording/transmitting ambient levels of various combinations of carbon monoxide (C), nitrogen oxide (NO), oxides of nitrogen (NOx), nitrogen dioxide (NO2), ozone (O3), and sulfur dioxide (SO2). The monitoring network is operated by Mexico City's RAMA staff. The staff is responsible for the proper function and quality of the whole network. The staff is highly qualified to perform their duties. This audit was performed under the U.S. EPA criteria for ambient monitoring stations. Known concentrations of calibration gas mix were introduced in each instrument and its output was reported. One-hundred percent of the evaluated equipment passed acceptable limit. This report has been reviewed in accordance with the U.S. EPA Agency's peer and administrative review policies and approved for presentation and publication. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

Williams, R.W., Wallace, L.A., Suggs, J.C., Evans, E.G., Creason, J.P., Highsmith, V.R., Sheldon, L.S., Rea, A.W., Vette, A.F., Zweidinger, R.B., Leovic, K.W., Norris, G.A., Landis, M.S., Stevens, C.T., Howard-Reed, C., Conner, T.L., Rodes, C.E., Lawless, P.A., Thornburg, J., Liu, L.J.S., Kalman, D., Kaufman, J., Koenig, J.Q., Larson, T.L., Lumley, T., Sheppard, L., Brown, K., Suh, H., Wheeler, A., Gold, D., Koutrakis, P., and Lippmann, M. Preliminary particulate matter mass concentrations associated with longitudinal panel studies "assessing human exposures of high risk subpopulations to particulate matter". 2001. EPA/600/R-01/086 (NTIS PB2002-100444).

10/15/2001

Contact: Ronald W. Williams

Abstract: The NERL Particulate Matter Longitudinal Panel Studies were used to characterize temporal variations of personal exposure to PM and related co-pollutants, including that of PM measured at ambient sites. These studies were fundamental in understanding the associations between personal exposure to PM, PM measured at ambient sites, and health effects, especially for susceptible sub-populations. Projects were designed to evaluate different sub-populations, regions of the country, seasons, and housing conditions. Susceptible sub-populations included chronic obstructive-pulmonary disease (COPD) patients, individuals with cardiovascular disease, the elderly, and asthmatics among others. These studies represented a cooperative efforts between the NERL and other scientific organizations. This report documents the progress of field data collections associated with the aforementioned studies and reports preliminary data from those studies where data validation has been completed. Collected data is being used to develop databases representing actual human exposures to particulate matter and related copollutants of ambient origin. These data fill a critical scientific need for the Agency in identifying potentially important exposure variables, as well as providing inputs for modeling and risk assessment. The U.S. Environmental Protection Agency through its Office of Research and Development partially funded and collaborated in the research described here under contract numbers 68-D2-0134 (QST Environmental), 68-D2-0187 (SRA Technologies, Inc), 68-D-99-012, 68-D5-0040 (Research Triangle Institute) and cooperative agreement numbers CR-827159 (Harvard School of Public Health), CR-827177 (University of Washington), CR-827164 (New York University) CR-820076 (University of North Carolina-Chapel Hill), CR-828186-01-0 (Shaw University). It has been subjected to the Agency's peer and administrative review, and it has been approved for publication as an EPA document. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

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Presented Published

Shrock, J., Bowser, J., Mayhew, W., and Stevens, R.K. South Florida mercury monitoring and modeling pilot study. 2001. EPA/600/R-00/102 (NTIS PB2002-100515).

8/28/2001

Contact: Roy B. Zweidinger

Abstract: In 1995, the South Florida Atmospheric Mercury Monitoring Study was established to investigate several likely sources of Hg, as well as transport and deposition mechanisms. Field operations began on August 10, 1995, and ran continuously through September 6, 1995. Source sampling was conducted at three facilities suspected of emitting Hg. The source sampling component investigated the chemical form and magnitude of Hg emissions from a resource recovery incinerator, a medical waste incinerator, and a coal-fired Portland cement kiln. In-stack measurements also included PM_{2.5}, elemental and organic carbon, trace elements, and trace gases. Field measurements were conducted at a network of five surface sites. Four surface sites were located in Dade County and one in Broward County. The monitor locations were chosen to represent a marine background site (Adams Key), three urban sites located near mercury emitting sources (Davie, Miami Springs and Dade County), and one site located west of the urban sites adjacent to the Everglades (Thompson Park). Day and night air samples were collected for PM_{2.5}, elemental and organic carbon, trace elements, and trace gases. Extensive meteorological data were collected. This report focuses largely on data completeness and the spatial-temporal variability of ambient concentration data. Although the data presented are only a portion of that collected under the overall study, it constitutes a valuable source of information on the chemical composition of the South Florida atmosphere with respect to Hg and other related pollutants.

RESEARCH RPT

Stump, F.D., Tejada, S.B., Dropkin, D.L., Loomis, C., and Pack, C. Characterization of emissions from malfunctioning vehicles fueled with oxygenated gasoline-ethanol (E-10) fuel-part II. 2001. EPA/600/R-01/053 (NTIS PB2002-107676).

6/28/2001

Contact: Frederick D. Stump

Abstract: A 1993 Ford Taurus and a 1995 Chevrolet Achieva were tested using three different fuels: (1) a winter grade (E-10) fuel containing 10% (vol.) 200 proof ethanol, (2) a winter grade (WG) fuel without any oxygen containing compounds, and (3) a summer grade (SG) fuel without oxygenates. Vehicle emissions were characterized at test temperatures of 75 (SG fuel only), 20, 0, and -20 degreeF. The vehicles were tested under a mode in which the vehicles were tuned to manufacturers specifications (NM mode) and under two simulated malfunction modes: 1) the oxygen (O₂ mode) sensor was disconnected and 2) the exhaust gas recirculating valve (EGR mode) was disconnected and plugged. The malfunction modes were not tested simultaneously. The vehicles were tested on the Urban Dynamometer Driving Schedule (UDDS) of the Federal Test Procedure (FTP). Four IM240 test cycles were run after each of the UDDS tests and the exhaust particulate matter (PM_{2.5} and PM₁₀), from the four IM240 driving cycles were collected on single filters. The gaseous emissions were collected and analyzed for total hydrocarbons, carbon monoxide, oxides of nitrogen, speciated (individual) hydrocarbons, speciated (individual) aldehydes, ethanol, methanol, 2-propanol, methyltertiarybutyl (MTBE) ether, and ethyltertiarybutyl (ETBE) ether. Hydrocarbon emissions generally increased as test temperature decreased for both vehicles, fuels, and test modes. The E-10 fuel reduced some emissions and increased others, while disconnecting the O₂ sensor increased emissions over the other two modes. The trend for carbon monoxide and oxides of nitrogen emissions showed a general increase in emission rates as the testing temperature decreased. When the O₂ sensor was disabled, the trend showed increasing carbon monoxide emissions and when the EGR valve was disabled it was observed that the oxides of nitrogen emissions generally increased. The emissions of the toxic compounds benzene and 1,3-butadiene tended to increase as the testing temperature decreased. Disconnecting the O₂ sensor generally increased the emissions of these toxic compounds when compared with the NM mode emissions. The E-10 fuel generally reduced both benzene and 1,3-butadiene emissions from both vehicles. The measured emissions of formaldehyde and acetaldehyde from the test vehicles show a general increase in emissions as test temperature decreased with both the base and E-10 fuels. The PM_{2.5} and PM₁₀ particulate emission rates were comparable. The particulate emissions from both vehicles followed the HC emission trend and increased as the test temperature decreased. The E-10 fuel reduced particulate emissions from the Taurus at all test conditions with the exception of when testing at 20 degreeF in the EGR mode but the effect of the E-10 fuel on Achieva PM_{2.5} were not well defined. The Taurus emitted more particulate matter than the Achieva at all test conditions except when tested in the NM mode with SG fuel. Both vehicles emitted more particulate matter when the O₂ sensor was disconnected. The information in this document has been funded wholly by the United States Environmental Protection Agency under Contract 68-D5-0156 to Clean Air Vehicle Technology Center, Inc. It has been subjected to the Agency's peer and administrative review and has been approved for publication as an EPA document. Mention of trade names or commercial products does not constitute an endorsement or recommendation for use.

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Presented Published

SYMPOS/CONF

Mitchell, W.J., Borci, T., Yee, S., Hicks, A., Simpson, G., and Schiff, H.I. Pollutant emission factors for a transportable detonation system for destroying unexploded ordnance. Presented at: UXO/Countermine Forum, New Orleans, LA, April 9-13, 2001. EPA/600/A-01/028 (NTIS PB2001-104619).

4/9/2001

Contact: William J. Mitchell

Abstract: The U.S. Environmental Protection Agency (EPA) discourages the disposal of unexploded ordnance (UXO) by open air and soil-covered detonations, because these processes cause toxic metals, organics and explosives to be released into the environment. This paper presents the results from an emissions testing study on an alternative UXO disposal technology (DeMil International Model T-10 transportable contained detonation system) while it was destroying 81-mm mortar rounds at the Massachusetts Military Reservation. The emissions testing showed that more than 98.8% of the Zn and more than 99.99% of the Cu, Mg, Mn, Fe and Al in the mortar rounds were retained in the T-10 and that the particulate emissions were 150 times less than those from an open air detonation. The views expressed in this paper are those of the individual authors and do not necessarily reflect the views and policies of the EPA. Scientists in EPA have prepared sections of this paper based on only a preliminary review of the study results and, therefore, their sections may be revised at some time in the future. This paper has been reviewed in accordance with EPA's peer and administrative review policies and approved for presentation and publication.

Lewis, R.G., Fortune, C.R., Blanchard, F.T., and Ellenson, W.D. Passive/diffusive samplers for pesticides in residential indoor air. Presented at: International Conference on Measuring Air Pollutants by Diffuse Sampling, Montpellier, France, September 26-28, 2001.

9/26/2001

Contact: Robert G. Lewis

Abstract: Pesticides applied indoors vaporize from treated surfaces (e.g., carpets and baseboards) resulting in elevated air concentrations that may persist for long periods after applications. Estimating long-term respiratory exposures to pesticide vapors in residential indoor environments using active (pump-based) sampling systems has been costly and burdensome on occupants. Diffusion-controlled passive sampling devices (PSDs), which do not require a noisy pump and can be situated unobtrusively within the home, would offer distinct advantages. The U.S. EPA is investigating the applicability of diffusive PSDs, semipermeable membrane devices (SPMDs), solid-phase microextraction (SPME), and other gas-sorbent partitioning samplers for estimating semivolatile organic compound (SVOC) pesticides in homes. This paper presents the results of the initial evaluations of two diffusion-controlled PSDs for determination of three pesticides in room air. This work has been funded wholly by the United States Environmental Protection Agency under contract 68-D-00-206 to ManTech, Inc. It has been subjected to Agency review and approved for publication. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.